August, 1959

The Mining Magazine

VOL. 101 No. 2. LONDON. PRICE : 3s. ; With postage 3s. 8d.

The Mining Magazine

PUBLISHED on the 15th of each month at SALISBURY HOUSE, LONDON, E.C. 2
for MINING PUBLICATIONS, LTD.

Editor : F. HIGHAM, A.R.S.M., M.Sc., M.I.M.M.
Manager : ST.J. R. C. SHEPHERD, A.R.S.M., D.I.C., F.G.S. *Chairman :* H. E. FERN, O.B.E., J.P.

Telephone : *NATional* 6290. Telegraphic Address : *Oligoclase*. Codes : *McNeill*, both Editions, *& Bentley*.

PRICE 3s. ; with postage 3s. 8d. Annual subscription, including postage, 35s. ; U.S.A., $6.00.

Vol. 101. LONDON, AUGUST, 1959. No. 2.

CONTENTS

EDITORIAL

POSSIBLY reflecting the change in the availability of seasonal native labour that has taken place in the past year the output of the South African gold mines continues to break its previous records. At July 31, 1958, there were 336,356 natives at work in the Rand and O.F.S. gold mines ; the comparable figure this year was 381,190. The figures for last month issued by the Transvaal and Orange Free State Chamber of Mines show the July output as 1,749,382 oz., which compares with the previous peak production of 1,699,968 oz. reported for June. In the first seven months of the current year 11,421,777 oz. has been produced, which suggests that the figure for the whole of the current year should certainly make a new annual record. It was reported earlier this month that the total working profit of the mines which are members of the Chamber for the three months to June 30 last amounted to £28,473,191, of which £20,530,568 is attributed to the gold and uranium producers. (The uranium profit is given as £6,811,943.) These figures also represent a new peak.

IN the year to December 31 last the gold mines of Australia treated 3,021,072 long tons of ore and recovered 874,819 oz. of gold, valued at £A13,669,046. As compared with the previous year there was an increase in tonnage of 70,061 and of 25,068 oz. in output, the average value of the ore treated being 5·79 dwt., against 5·76 dwt. In his address to the 58th annual general meeting of the Chamber of Mines of Western Australia held on May 26 in Kalgoorlie the president, Mr. R. J. Agnew, referred to the representations made to the Federal Treasurer by a deputation from the Chamber. These incorporated suggestions that there should be an increase in the maximum subsidy per ounce of gold being paid to the so-called marginal mines and a reassessment of the " capital used in the business " for those " mining companies whose original capital is out of proportion to the present-day value of capital used in carrying out mining operations." At the time it was considered the older established companies, formed on a lower nominal capital, were at a disadvantage when compared with that of more recently-formed companies.. In addition a request was made that consideration should be given to an allowance of 4s. per ton mined with a view to increasing development. In the outcome it was agreed that the subsidy to marginal producers should be raised from £2 15s. an oz. to £3 5s. and that small producers—that is, those with an output of less than 500 oz. annually—should receive £2 8s. an oz. subsidy in place of the £2 per oz. ruling at the time. The further requests the Chamber made were not granted, although it may in time become desirable to give some sort of aid for exploratory purposes. As Mr. Agnew said, while most of the West Australian gold-mining companies are at present doing considerable development such development cannot be said to be holding the ore reserves necessary for the continued existence of the mines, since it has only been sufficient to enable them " to develop in known lode channels where it was confidently expected that payable ore disclosures would take place," and exploratory development has not been carried out to the extent required for the future needs of the industry. Perhaps a new assessment of Western Australia's remaining gold reserves may soon be possible in the light of the encouraging drilling results that have been obtained by several of the operating companies in recent years. A note from our Australian correspondent elsewhere in this issue regarding a new find in the field shows that exploration may yet yield results.

As was the case with the July issue it has only been possible to produce a slimmer MAGAZINE in the current month, owing to the dispute in the printing industry. With the strike apparently settled it is hoped with the September issue to return to normal and to continue the programme originally planned for our 101st volume.

MONTHLY REVIEW

Introduction.—At the time of writing labour troubles in the metal industries in the United States have strengthened metal prices, while the continued buoyancy of British industry, in spite of recent strikes, maintains current business confidence.

Transvaal.—The output of the Rand and O.F.S. gold mines for June totalled 1,665,503 oz., making with 34,465 oz. from outside producers a total of 1,699,968 oz. for the month. At June 30 there were 383,903 natives at work in the gold mines as compared with 385,278 at the end of the previous month.

It has been reported that preparations are being made for shaft-sinking in the Western Areas Prospect (Waterpan Block) of JOHANNESBURG CONSOLIDATED INVESTMENT. Excavations for shaft collars are being dug.

At BUFFELSFONTEIN sinking operations proper are probably now under way in the sub-vertical shaft in the north-western section of the lease area. The payable footage developed in the second quarter averaged 610 in.-dwt.

In the June quarter sinking the Toni shaft at STILFONTEIN got well under way, and sinking the James shaft is now in its initial stages, while at VAAL REEFS preparations for the sinking of the No. 2 shaft system in the south-central section of the lease area were almost completed.

Orange Free State.—In the June quarter No. 1 shaft at FREE STATE SAAIPLAAS was completely equipped, after which development commenced and a total of 403 ft. advanced. Development in connexion with the station layout on 8 level exposed 345 ft. on reef, of which 290 ft. proved payable and averaged 11·3 dwt. per ton over an estimated stoping width of 50·0 in.

In the same period the supplementary ventilation shaft at FREE STATE GEDULD, in the No. 2 shaft area, has been completed to its final depth, and the main fans installed and commissioned. Development continued in the severely faulted, very high-grade zone south-west of No. 1 shaft. At WESTERN HOLDINGS, due to continued high development values from the No. 3 shaft area, where 1,350 ft. sampled averaged 1,644 in.-dwt. against 2,192 in.-dwt. over 500 ft. in the first quarter, sampled footage for the whole mine improved to 1,206 in.-dwt. from the previous average of 993 in.-dwt.

At ST. HELENA sinking operations proper in the mine's fourth shaft in the east-central section got well under way.

Diamonds.—Last month DE BEERS CONSOLIDATED MINES announced that diamond sales effected in the three months to June 30 through the Central Selling Organization totalled £21,611,905, of which £14,811,371 represented gem material.

Northern Rhodesia.—In his review accompanying the reports and accounts of NCHANGA CONSOLIDATED COPPER MINES for the year ended March 31 last, the chairman, Mr. H. F. Oppenheimer, said :

> Nchanga is firmly entrenched as one of the great copper mines of the world, with a potential which has not yet by any means been fully determined. Prospecting work is continuing on the Chingola and Mimbula orebodies, while the River-Lode has been de-watered and is being revalued with a view to further prospecting. The calculated ore reserves are now 167,000,000 tons and the present work promises to add considerable ore to this figure. At the same time, research is proceeding on the metallurgical problems connected with the recovery of copper from the banded sandstones which lie above the main orebody. Results of this work are encouraging and, if a successful method of extraction can be evolved, large tonnages of low-grade ore could be drawn from current and old underground workings as well as from the Nchanga open-pit without further major expenditure on development.

Production for the year under review was 139,442 long tons of copper, a record for the mine.

Last month shareholders of RHOKANA CORPORATION were informed that, with the agreement of the United Kingdom Atomic Energy Authority, the uranium plant was to be closed down on July 31. The plant, which started production in May, 1957, was erected to treat the small deposit of uranium-bearing ore in the Mindola orebody. This had an estimated life of about three years and most of the available ore has now been mined, it is stated. Total production to the end of June was 220,000 lb. of uranium oxide, on which a small profit was made. The cost of the company's uranium production is high, the report says, " and as the total expenditure on the plant has been recouped, and as there is at present a world surplus of uranium, it is considered opportune to close the plant now."

On July 27 the BRITISH SOUTH AFRICA COMPANY announced that its estimated gross revenue from mineral royalties, rents, and fees for the quarter ended June 30, 1959, after providing for the payment to the

Northern Rhodesian Government of 20% of the net revenue derived from the exercise of its Mineral Rights in Northern Rhodesia, amounted to £2,729,000.

New Guinea.—In the year to March 31 last, BULOLO GOLD DREDGING made an estimated net profit of $650,000, which compares with $403,000 in the previous year. In the year 4,855,605 cu. yd. dredged yielded 20,140 oz. of gold. The report for the final quarter stated that the earnings from gold production by Dredge No. 5 and the Widubosh sluicing operation were a little higher than in the previous year, while the Lae timber operation also yielded a satisfactory profit.

Dominican Republic.—Shipments of bauxite, which commenced from the Dominican Republic in January this year, have to the end of July totalled 189,000 tons. It is stated that the ALUMINUM CO. OF AMERICA'S bulk loading facilities from Cabo Rojo have enabled a rapid turn-round of ships; $14,000,000 has been spent by the company to develop the 60,000,000-ton deposits.

Canada.—At the end of July shareholders of the RIO TINTO COMPANY were informed that at a general meeting of PATER URANIUM MINES held in Toronto on July 28 the arrangement between the company and PRONTO URANIUM, which is managed by Rio Tinto in Canada, for the sale of its mining properties and equipment for 186,666 fully-paid shares in Pronto was approved. A resolution to liquidate Pater Uranium and to distribute its assets was also approved. Pater Uranium was incorporated in August, 1953, for the purpose of acquiring property in Spragge Township, in the Blind River area of Ontario, adjoining the Pronto property. No uranium ore-body was discovered, but a copper body has been outlined, containing an estimated 1,000,000 tons with an average grade of 2% copper. This ore-body is too small to justify building a mill on the Pater property, but on completion of its present uranium contract and any extensions the Pronto mill could be adapted to treat the Pater copper ore.

Portugal.—At the annual meeting of MASON AND BARRY last month shareholders were informed that it is intended to call an extraordinary general meeting during September for the purpose of capitalizing 23,147 shares of £1 each as fully paid and to issue to shareholders one free share for every eight held. The directors have also resolved to recommend at the same meeting that the authorized capital be increased by £790,000 to £1,000,000 for the purpose of being prepared for possible future developments—such as exploration for more mineral, afforestation, and the establishment of alternative industries. The operating result for the first half of 1959 has not been unsatisfactory, it was stated.

Consolidated Gold Fields of South Africa.—It has been announced in the past month that arising out of discussions with H.E. PROPRIETARY and NEW UNION GOLDFIELDS shareholders of those companies are recommended to accept the offer made by Consolidated Gold Fields for their shares. The previous offer to shareholders of the ANGLO-FRENCH EXPLORATION CO. has now become unconditional. In a recent circular shareholders of Consolidated Gold Fields have been informed that transference of operational supervision of the company's South African interests to a South African company have for some time been under consideration. As the result of an offer to acquire all the outstanding shares of the AFRICAN LAND AND INVESTMENT COMPANY that South African company will shortly become a wholly-owned subsidiary. It is then proposed to make the necessary arrangements for its name to be changed to GOLD FIELDS OF SOUTH AFRICA LTD.

Johannesburg Consolidated Investment Co.—With the recent dividend notice shareholders of the Johannesburg Consolidated Investment Co. were informed that the profit for the year ended June 30 last was £990,226. With the sum brought in the accounts show £1,299,352 available, of which a dividend equal to 4s. 6d. a share requires £808,500.

METAL PRICES

August 10.

Aluminium, Antimony, and Nickel per long ton; Chromium per lb.; Platinum per standard oz.; Gold and Silver per fine oz.; Wolfram per unit.

	£	s.	d.
Aluminium (Home)	180	0	0
Antimony (Eng. 99%)	190	0	0
Chromium (98–99%)		7	2
Nickel (Home)	600	0	0
Platinum (Refined)	28	10	0
Silver		6	6⅞
Gold	12	9	10
Wolfram (U.K.)		—	
(World)	4	17	0

Tin, Copper, Lead, Zinc } See Table, p. 72.

Fifty Years of Mining Geology

In a first note the author discusses changing thoughts on ore genesis

G. A. Schnellmann, A.R.S.M., Ph.D., M.I.M.M.

A reader of the first issue of the MAGAZINE could scarcely have been accused of appalling ignorance if he had asked " What is a mining geologist ? " Mining engineers still active in the profession can remember when there was no such creature ; some of them may still regard this upstart with suspicion. There had, of course, been many factual geological descriptions of mining fields before that time, as well as speculation on the nature and origin of ore-deposits, but the systemization of the data into a specialized branch of study was still in its infancy. Considering the antiquity of mining as one of man's activities, this may well seem extraordinary, but it must be recalled that the parent science itself was at that time little more than a centenarian.[1]

There is still a good deal of misapprehension about the function of mining geology. Much in the sense in which Shakespeare commented, " New presbyter is but old priest writ large," the mining geologist is frequently regarded as nothing more than a prospector clothed in a little brief scientific authority to conform with the spirit of this scientific age. While the mere discovery of ore-bodies is too narrow a conception of the mining geologist's job, it cannot and need not be denied that his function is essentially utilitarian. He is perhaps a technologist rather than a scientist, in the sense that he is concerned more with the application of scientific knowledge than with the pursuit of knowledge for its own sake, and McKinstry (1948) goes so far as to say that mining geology is " as much an art as a technology." Nevertheless this art is based on a scientific foundation and to quote the same authority " has been a profession in its own right for a generation or more." If its immediate practice demands the acquisition of much expertise and many techniques, its future value to the mining industry must depend on the present pursuit of fundamental matters seemingly of purely academic interest. Without therefore attempting a definition which, if it were to be concise, would be immediately open to the objections of purists, mining geology is regarded in the context of the MAGAZINE's Golden Jubilee as comprising all aspects of the fundamental nature and origin of mineral deposits other than the mineral fuels, and all those techniques and expertise which the mining geologist employs in the exercise of his profession. This twofold division into theory and practice also provides a convenient method of treating the subject for the present purpose.

Writing almost exactly midway through the period under review Crook (1933) stated : " A study of the history of the theory of ore-deposits shows that modern authors have not added very much of fundamental importance to the general conceptions set forth by early workers." A quarter of a century later that statement is still regrettably true, but this is not to be attributed to lack of constructive thought (or, for that matter, of vivid imagination) over the years.

By 1909 the tremendous growth in the rate of production of metals which has been such a striking feature of the 20th Century was already under way. The centres of major production had already ceased to be in the Old World and were to be found predominantly in North America. Either by coincidence, or more probably as a corollary of the relative decline of Europe as a mining centre, the schools of thought on ore-genesis had also migrated westwards. Such classifical hypotheses of ore deposition as the Plutonism of Hutton, the Neptunism of Werner, and the Lateral Secretionism of Sandberger, all formulated in Europe during the two preceding centuries, were out of fashion and were being challenged by workers in the U.S.A.

[1] The Geological Society of London was founded in 1807.

Perhaps this was due, at any rate in part, to the rigid and uncompromising way in which their protagonists set them forth. Field data now began to accumulate out of all proportion to their amenability to scientific, particularly experimental, treatment and, in consequence of this lack of objective criteria, theories tended to be unduly coloured by the individual's personal and necessarily limited experience. In passing, it may be said that little attention seems to have been paid to this aspect of speculative thought. It has been said that the best geologist is the one who has seen most rocks. Certainly it is to be expected that the most balanced views on ore-genesis will stem from the mining geologist who has seen most ore-bodies, and some of the early workers were inevitably restricted from this point of view, if only because of the state of development of the transport available to them as compared with the automobile and the aeroplane.

To revert to the state of thought at the beginning of this century, Van Hise (1901) regarded the vast majority of ores as being deposited from meteoric waters which derived their metal content from the rocks in the zone of percolation, but he did not entirely discount the direct igneous origin of some ores. By contrast with this view, Kemp (1902) pointed to the field evidence of spatial association of ore-bodies with igneous rocks and argued from this that waters of magmatic origin were the chief transporting agents, although he appears to have thought that they derived their metal and gangue content by leaching the parent magma and the overlying rocks. He conceded also that the mechanism of deposition was mingling with descending meteoric water.

Lindgren at this time apparently steered a middle course, and shortly before the MAGAZINE made its appearance he said (1907) of the role of magmatic waters: "Possibly the zeal of the advocates of this view may carry them too far, and it is by no means denied that important ore-deposits may be formed by sedimentary processes or by cold or hot circulatory waters of atmospheric origin."

In 1913, when the MAGAZINE was in its fourth year, there appeared the first edition of Lindgren's "Mineral Deposits," a book which has since continued to dominate thought on the subject. The author laid stress on the essentially physico-chemical nature of ore formation, and in consequence was able to visualize a number of different processes in an entirely consistent genetic classification. In this lay his principal contribution to thought on the subject, for many aspects of his detailed classification differed little from the views of earlier workers on the subject. He regarded most primary ore-bodies as being the result of the concentration of materials extraneous to the host rock, and subdivided them into two groups based respectively on concentration by meteoric waters and by hydrothermal waters which he described as "of uncertain origin," though he postulated that they were ascending. The latter he further classified into three types—hypothermal, mesothermal, and epithermal—distinguished by successively decreasing temperature and pressure as the waters ascended to higher levels in the earth's crust and characterized by a corresponding zonal arrangement of the ore minerals. This constitutes the first attempt to introduce a quantitative element into the theory of ore-deposition. Various modifications of the scheme have been proposed, notably by Graton (1933) who introduced the terms "leptothermal" (between meso- and epithermal) and telethermal (above epithermal), but in principle the Lindgren classification remains. Some have almost seemed to rank Lindgren's classification with the scriptures as a revelation of truth, and though few thinking mining geologists now accept it without some reservations, it is salutory to reflect that the debunking of authorities is currently a fashionable sport. Lindgren's profound influence on the philosophy of ore deposition should not be under-estimated. None of the alternative theories proposed has been any more free from objection, and few as stimulating or provocative of ideas.

One of the mining geologists who disagreed with the Lindgren conception so completely as to propound an entirely different genetic mechanism was Spurr (1923), who introduced the conception of "ore magmas." According to his theory, ores are "later products of differentiation from magmas" which are injected as "highly concentrated solutions or almost partly fluids". The phenomenon of zonal deposition was explained as a sequence of magmatic stages. The most recent experiment in the unorthodox is that of Brown (1950), which is in some respects reminiscent of Spurr's theory. Brown proposes what he describes in a subtitle as "A Metallurgical Interpretation: An Alternative to the Hydrothermal Theory."

By appeal to mineral paragenesis and zoning he infers that " ores were vaporized, chiefly as simple mineral substances, from horizons deep within the earth's crust, at which they had collected by various processes during the fusion of the encompassing rock materials." The sequence of deposition he relates to the specific gravity of the ore-minerals. This necessitates, as a source of all sulphide ores, " a reservoir in which many complex ore-forming substances are stratified gravitationally " as in a blast-furnace.

Both these dissenters were inspired by the imperfections of the hydrothermal theory and produce intriguing alternative explanations of certain phenomena. Considered in their entirety, however, they are not themselves less open to valid objections to certain aspects.

One of the criticisms levelled against the general theory of the magmatic origin of ore-deposits is that in certain cases—notably, the type of lead-zinc mineralization found in the Tri-State district of the U.S.A. and the Pennines of this country--there is no evident igneous source. The explanation that such a source lay at depth was not unnaturally ridiculed as too facile. However, following on Dunham's clear demonstration in 1934 that the North Pennine ore field showed zonal distribution of minerals, which it would be hard to explain by the action of meteoric waters, a geophysical examination of this area was carried out by gravimetric methods many years later. The results, published in 1957, are entirely consistent with the presence of a granite mass which rises to within 5,000 ft. of the surface, and around which the mineral zones are symmetrically disposed. As a vindication of the general theory and a contribution to the study of ore-deposition, this important piece of research has not received the recognition it deserves. Five thousand feet is no great depth for a modern core-drill, and it would be a fitting conclusion to this piece of research if such a hole were drilled. There are in fact rumours that H.M. Geological Survey have included this project in their programme.

Deposition of ore is admittedly not determined solely by temperature and pressure conditions, and Bateman in his " Economic Mineral Deposits " (1942) went so far as to reject them entirely as a basis of classification, proposing instead a system based on the morphology of ore-bodies. Each to his taste, of course, but to the writer this extreme view seems to beg as many questions and to be open to as many objections as the system it seeks to replace, as well as being sterile by comparison.

Ore-deposition is undoubtedly influenced by environmental factors, notably by structure. No individual can claim credit for propounding the theory of the influence of structure on ore-deposition. As a result of the detailed geological mapping of ore-bodies which became the vogue some time in the '20's, a whole body of evidence accumulated and was co-ordinated by Newhouse (1942). By sheer weight of the numbers of instances, which ruled out any reasonable possibility of a fortuitous association, it was demonstrated that ore tended to occur preferentially in recognizable structure environments. These might be features of the vein structure itself, such as a preferred direction of strike or a critical value of dip (it being scarcely necessary to say that veins in nature depart markedly from the geometrically true plane commonly depicted in text books), or structures in the country rock, notably the impounding structure which arises, for example, in the crestal region of an anticline when a rock of relatively low permeability and tendency to fracture, such as shale, overlies a rock—*e.g.*, limestone which fissures readily and creates a channel in which the ore-forming fluid could ascend unimpeded. This principle of structural control has proved to be a most valuable tool. As Sullivan (1949) has remarked, the protagonists of the empirical structural approach " found quite a lot of ore " but seemed to assume that " a favourable structural trap is in itself a self-sufficient explanation for the occurrence of an ore-body," the perhaps natural but arid result of this philosophy being the affirmation that ore-search has nothing to do with geology and " is mainly a problem of geometry and diamond drilling."

All the trends of thought already mentioned are concerned essentially either with the nature of the ore-forming processes themselves or, at the most practical, with the location of ore-shoots within an ore-body and of ore-bodies within an established mining-field—established almost without exception in the first place by out-cropping mineralization. Little attempt has been made to answer the larger and more fundamental—and taking the long view for a civilisation so largely dependent on minerals the more important—question as to why mining fields are where they are, or to collect and make a

critical study of relevant data. Among the few such approaches, Buddington (1927, 1933) was probably the first to co-ordinate and publish data on the spatial relationship between certain types of mineralization and certain kinds of rock, though he would probably not wish to claim that some, perhaps much, of this had not previously been known. The first tentative suggestion of a " metallogenetic province " was outlined by de Launay in the 19th Century, but, so far as the writer has been able to ascertain, the only attempt to develop the idea of a general pattern of distribution of mining fields within the tectonic framework on a continental scale is that of Billingsley and Locke (1939), who deduced from a comprehensive study of mining districts in the U.S.A. that their position has been determined by " orogenic crossroads "—*i.e.*, structures resulting " from intersecting or superimposed deformations of different ages." To quote two examples, Colorado districts show intersecting pre-Cambrian and Tertiary structural elements, and Bisbee has Tertiary superimposed on late Paleozoic folding. This stimulating and constructive idea points, as the authors note, to the need for extension of detailed mapping to the regions between established mining districts. ". . . such regional mapping may disclose new, hidden districts just as district mapping has disclosed new, hidden ore clusters."

The most recent and most startling theory on the regional distribution of mineral deposits comes from Professor Allais (1956). Basing his thesis on a study of mineralization in the Sahara, he argues in a stimulating though not incontrovertible way that it has little, if indeed anything at all, to do with geology, but is entirely a matter of statistics. Such a proposition was perhaps to be expected sooner or later in these days when the statistician is omnipresent. In fact, it is fair to say that as the MAGAZINE'S Golden Jubilee dawns, the only thing finally needed to prove that the problem of ore-genesis is receiving the full 20th Century treatment is a psychiatrist's pronouncement on the subject !

In conclusion, a review of our state of knowledge of the fundamentals of ore deposition in 1959 as compared with 1909 can be nothing but a jeremiad. We are no more certain of them now than we were then, and our speculations promise no greater fruit. The mining geologist's approach to his task is essentially empirical, and empiricism both fails to satisfy the intellect and faces the bleak practical prospect of a field of ever-diminishing returns. If civilization is to continue, and to continue to be dependent on mineral raw materials, there must needs be a greater concentration of research, and therefore perforce of money, into the fundamental aspects of the nature and location of ore-deposition. Funds seem to be readily available for research into problems of immediate practical importance—*e.g.*, mineral dressing, which is after all the end process—but little enthusiasm has been shown for expenditure on research (as distinct from prospecting) in the perhaps less tangible field of assuring continued supplies of ore. So far as the writer is aware, the only important contribution to this has been the foundation by the Anglo American Corporation of South Africa of a research institute of African geology at Leeds University. As reported in the MAGAZINE (November, 1955) this institute will have as one of its primary objects " fundamental research into the origin of mineral deposits generally."

In a further note the writer proposes briefly to review the modern techniques adopted by mining geologists, their " tools of trade " perhaps ; such a review will certainly strike a note more in keeping with a jubilee celebration.

Warren Spring Laboratory

On June 29 Viscount Hailsham, Lord President of the Council, officially opened the Warren Spring Laboratory at Stevenage. This establishment, set up " to carry out process research and development over a wide field not limited to particular areas of technology," replaces the old Fuel Research Station. However, of the work carried out at that laboratory, only two programmes have been transferred to the new station—namely, research on the abatement of atmospheric pollution and on the synthesis of oils and chemicals by the Fischer-Tropsch process. Of interest to the mining industry, however, as many will be aware, was the decision to start research in the field of mineral processing.

The Mineral Processing Division at Warren Spring is intended to serve the mining industry at home and overseas by developing methods of beneficiation of hitherto unworked deposits, by effecting improvements in processes, and by developing processes for the extraction of mineral or metal products from waste or dump materials.

Radioactive Minerals in Southern Nyasaland

An account of occurrences at Tambane and on the Mwanza Fault.

V. L. Bosazza, D.Sc., M.I.M.M.

Introduction

Geological parties of the New Consolidated Gold Fields, Ltd., investigated a large area in Southern Nyasaland in 1956, and again in 1957. In this large area, bounded by the Shire River on the east, the Blantyre-Salisbury Road on the north, and the Nyasaland-Mozambique Border on the west, a number of radioactive and other minerals have been found. Members of the United Kingdom Atomic Energy Authority and the Nyasaland Geological Survey carried out the initial investigation and to them the author is greatly indebted for assistance. Mr. James H. M. McNaughton, formerly director of the Nyasaland Geological Survey, and Messrs. K. Bloomfield, M. S. Garson, and S. Morel gave liberally of their knowledge of the area, and Mr. Garson separated the first betafite that was examined. Messrs. C. de Jongh and G. D. Garlick assisted in the field traversing, and many of the fine specimens that were examined were found by them. Dr. R. A. Pelletier, consulting geologist, New Consolidated Gold Fields, directed the operations and to him the author is indebted for much help. He is also indebted to New Consolidated Gold Fields who have given permission for this article to be published. Mr. C. F. M. Bawden, of the same Company, did all the examination of the routine samples sent down, and his identifications in the field were of the greatest value. All the mineralogical work described in this paper was done in the Department of Geology, University of the Witwatersrand, and the author is grateful for the facilities placed at his disposal. Mr. van Biljon instructed him in the use of the differential thermal analysis apparatus which he had constructed.

Geology of the Tambane and Mwanza Fault Areas

The geology of the Tambane-Salambidwe Area has been described by W. G. C. Cooper (1952) and, while the author differs considerably from Cooper on the degree of the nephelinization process of the Tambane massif, any further contribution to geology of the whole area requires separate treatment.

The Tambane massif consists of old Basement Complex rocks in two ranges, the eastern being the higher. These rocks in the Tambane range are mainly hornblende- and biotite-gneisses, often with a great deal more feldspar than ferro-magnesium minerals and with minor amounts of quartz. There are some quartz-feldspar pegmatites, but they are better developed away from the mountain mass itself and the zone of nephelinization than in the mountainous area itself.

The most notable pegmatite is the Sigulane occurrence, from which monazite has been dated, while more recently betafite has been found along its eastern edge. Along the western slope of the Western Range, corundum and zircon occur in quite coarse crystals, as well as uraninite, betafite, allanite, molybdenite, monazite, columbite, ilmenite, and magnetite. These minerals are not necessarily in pegmatitic rocks, but mainly occur in quartz-granulite and some schists. as well as in feldspathic gneisses. The pegmatites contain only a small amount of mica, some of it lepidolite. The rocks dip regularly to the west and the strike of gneissocity is almost true north-south.

The rocks of the Mwanza Fault area are far more quartzose and there are more schists. They strike at 130°–135° T.N.—*i.e.*, at an oblique angle to the Tambane rocks—and dip to the south-west. These rocks are considered to be a younger formation, and this has been postulated before by Cooper. The radioactive minerals found are davidite, brannerite, and allanite. No monazite has been found, nor have betafite or uraninite. The radioactive minerals are all within two miles of the Mwanza Fault, which is a large fault of rift valley type.

Table 1

	(1)	(2)
SiO_2	34·80	31·45
Al_2O_3	ca. 21·00	30·80
Fe_2O_3	5·30	15·00
FeO	9·90	
TiO_2	1·10	0·30
MnO	not det.	not det.
CaO	1·47	0·98
MgO	0·88	0·38
Rare Earths	19·70	18·87
$+ H_2O$	2·18	1·20
$- H_2O$	1·66	1·20
	100·69	

(1) Allanite from Malico Village, Tambane Market. Analyst V.L.B.

(2) Allanite from Traverses M. 28–29. Mwanza Fault. Analyst V.L.B. Sample separated by bromoform and then electro-magnetically, removing some magnetite.

There is no nephelization at all along the Mwanza Fault and this phenomenon makes up only a small part of the Tambane mass. Trenching has shown that the amount of nephelinization is far less than that considered by Cooper.

Cutting the area are two types of dykes : (1) Dolerite types, always non-radioactive, and (2) microsyenites or solvesbergite dykes, which are very often slightly radioactive.

Table 2

	(1)	(2)	(3)
SiO_2	3·4	—	0·58
Al_2O_3	0·2		—
Fe_2O_3	not det.		—
TiO_2	6·5	tr.	0·36
Nb_2O_5	40·0	55·0)	62·7
Ta_2O_5	18·25	18·0)	
H_2O	4·8		
$H_2O -$	—		2·24
$H_2O +$	—		5·47
SnO_2	not det.		—
FeO	not det.		—
CaO	3·7		—
MgO	nil		—
$(Ye\ Er)_2O_3$	nil		—
$(Ce\ La)_2O_3$	nil		—
U_3O_8	20·85	16·08	28·3
ThO_2	nil		—
Pb	0·2		—
MnO	not det.		—
	98·27		99·65

(1) Betafite from Tambane, Eastern Range. Analysis by Gold Fields Laboratories.

(2) Partial analysis of first betafite recovered from Quarry, Eastern Range. Analysis by Gold Fields Laboratories.

(3) Betafite from Quarry, Eastern Range, cleaned in heavy liquids and hand-picked. Analyst V.L.B.

The Radioactive Minerals

The radioactive minerals appear to be rather unique in their occurrence. Those so far reported from Tambane are, in order of decreasing radioactivity, uraninite, pitchblende, betafite, samarskite, davidite, monazite, allanite, and zircon, with minor radioactivity in sphene. So far, betafite and zircon have been found to be most widespread and zircon is in greater abundance in most rocks than any other accessory mineral. Zircon, allanite, and monazite have been found in coarse-grained crystals that can be described as pegmatitic, but, with the exception of the Sigulane pegmatite, where the monazite can be clearly seen to be replacing the feldspars along joint planes most commonly at right angles to the direction of the pegmatite, the occurrences are not in pegmatites. Crystals of about 1 cm. length of betafite have been found on the Eastern Range and rather smaller specimens of a black betafite in the N'tandwe Stream, west of Sigulane Village. The main occurrences of betafite are in small equigranular, often well-rounded grains of less than 1 mm. diameter. As uraninite and pitchblende were found only after the laboratory work was completed in South Africa, they are not discussed further here, but Mr. C. F. M. Bawden identified them with the secondary minerals gummite, uraphane, and autunite. There are some grains of allanite in the uraninite.

Allanite. The allanite found in this area, as well as along the Mwanza Fault, almost invariably contains clear quartz as much as 5–8 mms. diameter. Near Malico Village, at Tambane Market, a minute vein of pyrite was noted in one specimen and dispersed grains have been noted in other cases. Mixtures of coarse-grained monazite and allanite in an epidote-rich rock occur just near the village of Caera, on the road from Tambane Market to the Rest Camp. The chemical composition is given in Tables 1 and 2 and as this is rather different to that given by Dr. A. P. Millman, notably as regards the alumina and calcium oxide contents, it is permissible to discuss the methods of analyses used in this work.

Doelter (1917) shows a silica variation in allanites of 30% to 39% and of *plus* water from 0·33% to 5·9%, so that from this the samples are normal and fresh. The beryllium oxide can vary from a trace to 0·42, but these samples contain little or no BeO, according to the Gold Fields Laboratories and the separation done by the author. In weathered

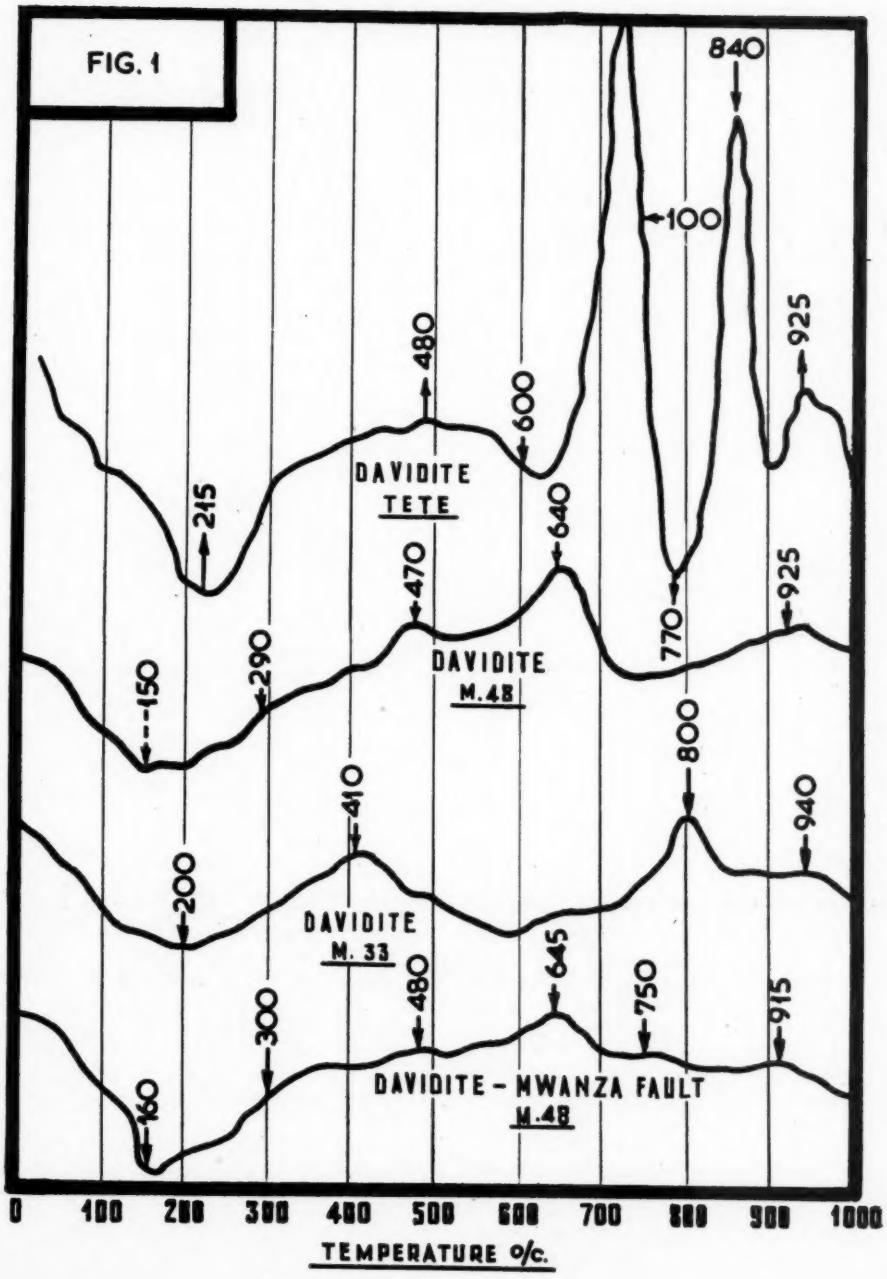


FIG. 1
840
100
925
480
600
215
DAVIDITE
TETE
640
470
925
770
DAVIDITE
M.48
150
290
800
410
940
200
DAVIDITE
M. 33
645
480
750
915
300
160
DAVIDITE - MWANZA FAULT
M.48
0 100 200 300 400 500 600 700 800 900 1000
TEMPERATURE o/c.

samples of allanite the combined water ranges from 7·34% to 14·63%.

It is remarkable that, both at Tambane and the Mwanza Fault area, with high tropical temperatures and humidities and relatively flat country, where the samples were found, the allanite should show so little alteration. The uranium oxide as U_3O_8 ranges up to 4·8%, and Table 3 shows some radiometric assays done by Mr. C. F. M. Bawden.

Some of the radioactivity is due to small amounts of monazite present and the monazite may be more radioactive than the allanite, for one sample from Schott's Trench, containing about 2% to 3% monazite and about 20% allanite gave an equivalent radioacitvity of 0·36% eU_3O_8.

Table 3

Locality.	*Allanite.* $e\ U_3O_8$%	*Zircons.* $e\ U_3O_8$%
Chikoleka . .	—	0·9
Village . .		0·6
Sigulane . .	0·13	—
Pegmatite . .		
Schott's Trench .		
Mwanza Fault		
M. 28–29 . .	0·17	
M. 21 . .	0·20	
M. 24 . .	0·15	
Tambane S.4.E. .	—	Weakly radioactive.
Malico Village .	0·13	
Near Rest Camp .	0·17	
Tambane Market .	0·15	

The other constituents are normal for allanites with the exception of alumina and calcium oxide. The calcium oxide content of allanites runs from 7% to 12% and alumina about 12% to 14%. Dr. A. P. Millman determined by spectrochemical methods 11% in a sample from Traverse No. M.21 on the Mwanza Fault. The author used the methods described by Schoeller and Powell (1955) in this analysis, following the oxalic acid separation tor the separation of the rare earths. Double precipitations were used throughout, except that in the case of the ferric oxide, titanium dioxide, and alumina, a treble separation was used. The oxalic acid was destroyed by means of strong nitric acid, the solution being taken to low bulk and boiled thoroughly. It is possible that some of the calcium oxide was precipitated with the alumina. Unfortunately, as the author had to return to Nyasaland, he could not repeat the analysis.

The important points are not affected by these two components—namely, the low combined water, the normal ferrous oxide content, and the absence of beryllium, which means that there is no gadinolite present. Allanite is weakly radioactive as compared with the cyrtolites from Tambine and, therefore, in small quantities, cannot contribute much to the radioactivity of a rock—for example, the solvesbergite dykes. In small particles allanite is often difficult when it is metamict to distinguish from, say, translucent haematite.

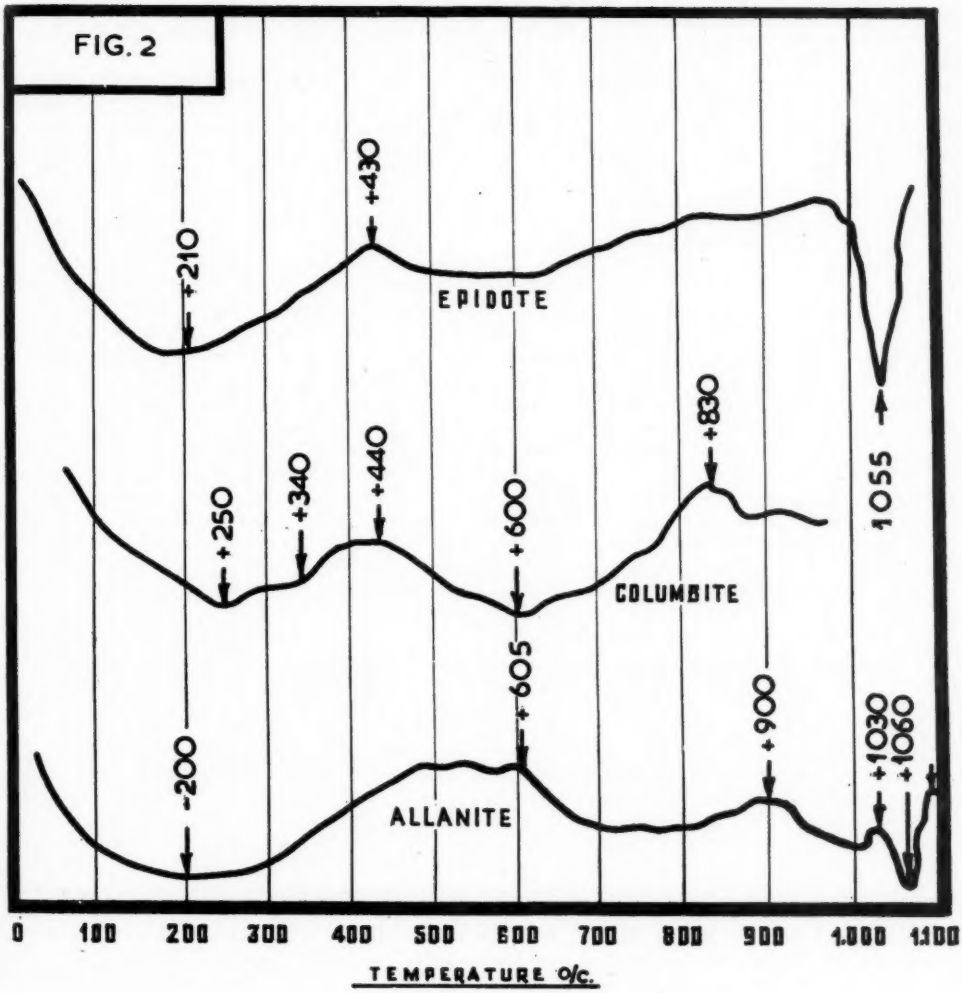
Zircon (cyrtolite).—Mr. C. F. M. Bawden suggested that the Tambane minerals, which fluoresce a golden yellow under the ultraviolet lamp and are radioactive, should be called cyrtolite. The following determinations were made for combined and hydroscopic water on samples from the Little Ngona River and S.4.E. :—

Sample.	$+ H_2O$	$- H_2O$
Cyrtolite S.4.E. .	1·48	1·07
Little Ngona River .	0·44	0·47

This would probably give, on a moisture-free basis, 1·5% and 0·47%, respectively, so that there is a distinct difference in the combined water of Eastern Range and the Little Ngona River and, as can be seen from the radiometric assays made by Mr. Bawden, the radioactivity is also very different (Table 3).

The Tambane cyrtolites are very markedly zoned and a number of crystals were cut parallel to the base and also to a prism. The crystals show the characteristic irregular cracks of zircons, and often along these cracks a yellow-brown translucent material, very difficult to determine, occurs. There are two types of inclusions—(a) plagioclase feldspar in irregular grains and not optically oriented in any way with the zircons and (b) a dark-brown almost opaque mineral, which shows alterations to the yellow mineral. It is non-pleochroic and so absorbent that it is difficult to determine, but it does not appear to be normal allanite, although it may be highly metamict.

Betafite.—The first identification suggested this mineral was pyrochlore. However, the first crystals found were recovered from the Eastern Range, in September, 1956, by Mr. C. de Jongh and these were measured by Mr. J. w. van Biljon by means of a contact goniometer as the crystals were earthy and very rough. Using the usual nomenclature, he obtained the following measurements :—



(001) Ô	.	55° 24′
0′ Ô″	.	70° 71′
0 Ô″	.	73°
m Ô″ ′	.	35°
mÔ′	.	38°
0′ Ô .	.	108°
m m̂′	.	90°

This gives the cube, octahedron, and rhombo-dodecahedron. A specimen sent from Madagascar by M. Besairie has the same earthy appearance and although the crystal is far better the crystallography appears to be the same.

Lacroix (1922) has described the betafite and associated minerals from Madagascar and he distinguished them from pyrochlore by chemical methods, principally the higher uranium content and the notable absence of the alkalies and fluorine. A test made on the cleaned sample from the Eastern Range did not give any fluorine. Lacroix notes that the minerals are hydrates, so that their chemical composition cannot be fixed exactly. The crystals from Madagascar are cubic, the cube and rhombic dodecahedron being common Optically those from Madagascar are brown-

green with yellow alteration products.

Owing to the metamict nature of the radioactive minerals at Tambane, the author confined his attention to differential thermal analyses and applied the method to davidite from Tete and the Mwanza Fault-Tambane betafite, epidote, allanite, columbite, and the non-magnetic fraction-methylene iodide sink from T.16/1/1. The results are given in Figs, 1. 2, and 3. These minerals can all be dealt with together and their relationships discussed later, with the occurrence in the various rocks.

Data on the differential thermal analyses of betafite, davidite, samarskite, and many uranium minerals have been published by Kerr and Holland (1951), and of uraninite, magnetite, ilmenite, and chromite by Heystek and Schmidt (1953). Kerr and Holland have made the most detailed study of davidite so far published, and their work includes chemical analysis, differential thermal analysis, and X-ray diffraction analysis after heating to 1000° C. These workers found that davidite from Mavudze, Moçambique, on two different specimens gave an exothermic reaction at about 670° C. to 680° C. and on another at about 800° C. Davidite from Olery, South Australia, on the other hand, gave a small exothermic peak at 470° C. a rather smaller endothermic peak at 573° C. (quartz), and then the same two peaks at about 680° C. and 800° C.

Two specimens analysed from Moçambique (Tete) gave reproducible curves, and one is given in Fig. 1. Both specimens were fresh and showed a considerable amount of water coming off at 215° C., a small endothermic reaction at just over 600° C. (which cannot be quartz, as there is no visible quartz at all in the specimen), a very notable exothermic reaction at about 700° C. and another at 840° C., with a smaller one at 925° C.

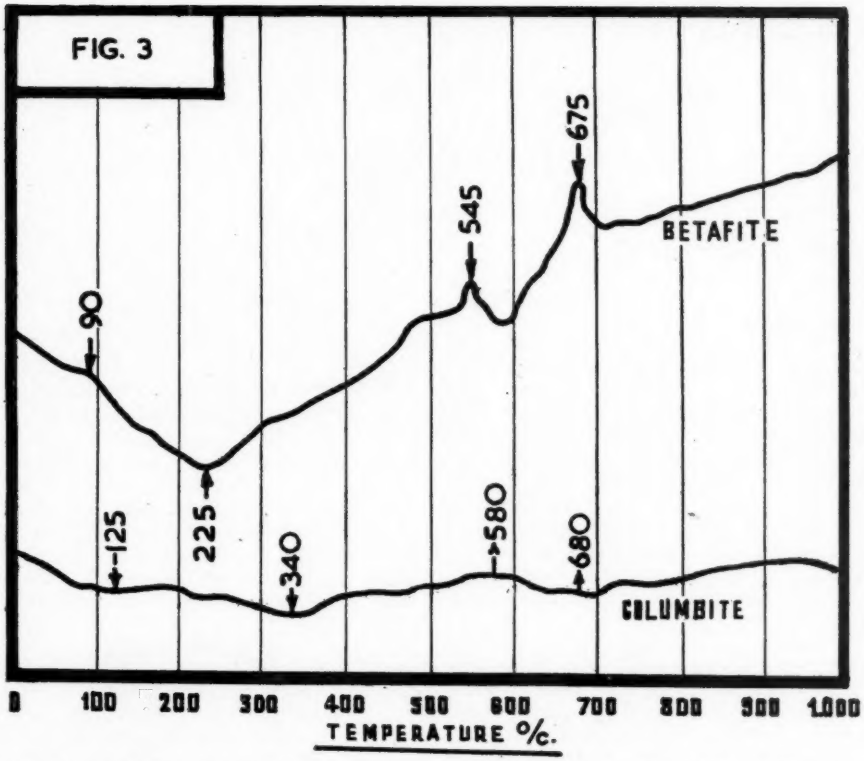
Two specimens from two different trenches at a site called M. 48 just east of the Mwanza River and near the Mwanza Fault in Southern Western Nyasaland, and only about 40 to 50 miles east of the Tete deposit, gave identical curves but differing somewhat from the Tete material. The notable differences are that for the same size sample the exothermic reactions at 700° C. and about 800° C. (same resistances in the circuit) are much smaller. These exothermic reactions are most probably due to oxidation, but it can be noted that Kerr and Holland found that the metallics associated with the Olery davidite gave small or negligible peaks. The exothermic peak at about 670° C. is also common to betafite, according to Kerr and Holland ; but the author found an additional exothermic peak at 545° C., this on a very pure sample of a crystal of betafite from Tambane, Southern Nyasaland.

It does not seem possible to distinguish samarskite and betafite nor davidite by the differential thermal analysis method alone, except that betafite has water of combination. Columbite, with which the Tambane betafite is closely associated, shows very small peaks even using the most sensitive methods, and its effect can be neglected. The exothermic peaks in the case of betafite appear to be due to the oxidation of the uranium part of the mineral.

According to Heystek and Schmidt, magnetite gives broad exothermic peaks and ilmenite much smaller ones. The two specimens of davidite from Tete are very feebly magnetic and contain little or no magnetite, and the same applies to the M. 48 material. On the other hand, the M. 33 sample, which is along the Mwanza Fault but further east, contains ilmenite and some magnetite and, as pure large samples could not be obtained, the curve would be expected to show some magnetite characteristics. The peak at 410° C. may be the same as Heystek and Schmidt's at 360° C. for magnetite. The absence of the peak at 670° C. to 700° C., which seems to be characteristic for the M. 48 and Tete davidites, can be noted.

A curve for epidote (Fig. 2) is very similar to that given by Heystek and Schmidt—namely, a marked endothermic peak at about 1000° C. All the determinations the author made were on air-dried samples, as he was particularly interested in the effect of weathering in this hot and very humid climate. It has been suggested that the brown betafite is a weathered form of the black to greenish-black type. Allanite, which is a weather-resistant mineral, was also examined, and the curve is given in Fig. 2. The author cannot trace other data on this mineral, so that it is not possible to deduce very much at this stage.

Betafite crystals have been found in some of the small streams on the western side of Tambane, about 1 cm. diameter, which are jet black in colour and have been weathered out from feldspathic gneisses similar to those in which the betafite, yellow-brown in colour, from the Eastern Tambane Range occurs ; it is doubtful whether this is due to simple hydration, although Lacroix (1921) made that



point in his original work on the Madagascar minerals.

References

(1) Bannister, R. D., and Horne, J. E. T. (1950). "A radioactive mineral from Moçambique, related to davidite." *Mineral Mag.*, **29**: 101–112.

(2) Bridges, R. J. (1936). "On a suite of igneous rocks near Kidete, Tanganyika and associated development of copper ore." *Trans. Geol. Soc. S. Afr.*, **38**: 1–30.

(3) Cooper, W. G. C. (1946). "The Geology of the Tambane Corundum Field." Ann. Report Geol. Surv. Dept. Nyasaland.

(4) Cooper, W. G. C. (1957). "The Geology and Mineral Resources of Nyasaland." Nyasaland Geol. Surv. Dept. Bull. No: 3.

(5) Davidson, C. F. and Barnett, F. A. (1950). "The uranium deposits of the Tete District, Moçambique." *Mineral Mag.*, **29**: 291–303.

(6) Dixey, F., Campbell-Smith, W. and Bissett, C. B. (1955). "The Chilwa Series of Southern Nyasaland." Geol. Surv. Dept. Nyasaland. Bull. No. 5: 71 pp.

(7) de Luna, I. S. and Freitas, F. (1953). "Geologia e metallogenia dos depositos de uranio do Val do Mavudsi." *Serv. Indsrt. Geol. Moc. Bol.* No. 11: 32 pp.

(8) Doelter, C. (1916). "Handbuch der Mineralchemie; Band IV." Erste Abd. T. Steinkopf, Dresden.

(9) Edwards, A. B. (1940). "A note on some tantalum-niobium minerals from Western Australia." *Proc. Austral. Inst. Min. Met.*, 120: 731–744.

(10) Edwards, A. B. (1954). "Textures of the Ore Minerals." Austral. Inst. Min. Met.

(11) Harker, A. (1939). "Metamorphism." Methuen and Co., London.

(12) Heystek, H. and Schmidt, E. R. (1953). "The Technique of Differential Thermal Analysis and its Application to some South African Minerals." *Trans. Geol. Soc. S. Afr.*, **56**: 149–176.

(13) Kerr, P. F. and Holland, H. D. (1951). "Differential Thermal Analysis of davidite." *Amer. Min.*, **36**: 563–572.

(14) Lacroix, A. (1922). "Minéralogie de Madagascar." Tom3 1. A. Chalamel. Paris. 624 pp.

(15) Nininger, R. D. (1954). "Minerals for Atomic Energy." D. van Nostrand Co., New York. 367 pp.

(16) Schoeller, W. R. and Powell, A. R. (1955). "The Analysis of Minerals and Ores of the Rarer Elements." Charles Griffin and Co., London.

(17) Sullivan, C. J. (1957). "Heat and Temperature in ore formation." *Econ. Geol.*, 52: 5–24.

(18) Whittle, A. W. G. (1955). "The radioactive minerals of South Australia, and their petrogenetic significance." *J. Geol. Soc. Austral.*, **2**: 21–45.

Mining Machinery Exhibition

A final review of some of the exhibits noted

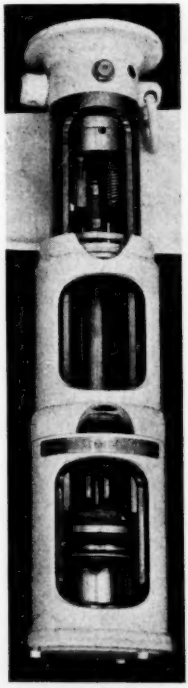
Following the notes which appeared in the June and July issues some further particulars are given here of items of interest seen at the exhibition, which attracted an attendance of over 24,000 visitors of whom 10% were from overseas. More than 50 countries were represented, including almost all the European countries, the U.S.A., Argentina, Bolivia, Colombia, Japan, the People's Republic of China, South Korea, Formosa, Turkey, Iran, Lebanon, Israel, and, of course, many from the British Commonwealth. The symposium on shaft sinking and tunnelling organized by the Institution of Mining Engineers attracted over 750 registrations of whom some 200 were from 32 overseas countries.

Roof Control

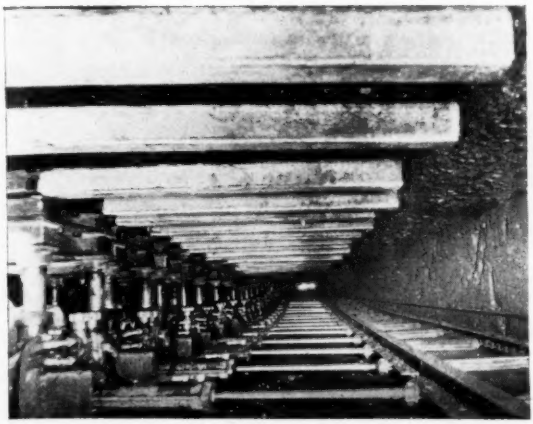
A type of hydraulic yielding prop was shown by the **B.R.D. Company, Ltd.,** a feature of which is that all valves and controls are situated in the head and can readily be replaced underground. A short stroke in the pump handle ensures quick and easy setting and a clip-on hose from a refill unit makes topping up easy. The illustration shows the prop with some of the outer casing cut away to reveal the inner parts. It is known as the Polar prop and the full range consists of 29 sizes.

A self-advancing support system was demonstrated on the stand of **Gullick, Ltd.,** using the Seaman chock illustrated here, which is also hydraulically operated. These supports have been used, it is stated, in seams from 2 ft. 7 in. to 6 ft. and recent developments have produced supports for a 2 ft. seam and also for a 7 ft. seam. In addition a mechanical support (two-legged unit) has been introduced. The supports are flexible and can be used with all types of power loaders.

Yielding roadway supports known as the British Usspurwies system were demonstrated by Hollybank Engineering Co., Ltd. (**Hawker Siddeley Industries, Ltd.**), who point out that a roadway which is changing in size and shape must have at least one flexible joint in the support. In the system described there are three flexible points—the joint at the crown of the arch (Fig. 1) and where the two arch legs enter the yield boxes on either side. The top joint consists of two staggered rounded lugs which take the weight and roll upon each other as the joint flexes, shoulders being provided to keep relative movement within reasonable limits. A bolt holds the two halves of the joint together but is not normally subjected to strain. The girder members have a box section which provides a good all-round resistance. The yield box (Fig. 2) is designed to slide under a force



B.R.D. Prop.



Seaman Chock Installation.

(Courtesy N.C.B.)

only slightly below that which a particular section can resist without distortion. An important feature is that its action is, within practical limits, independent of side pressure. When the support is set frictional resistance is established between the arch leg, A, the

Fig. 1.

wooden wedge, H, the brake shoe, B, and the rear side of the box S. When pressure, Q, is applied from the side of the roadway, the foot of the arch moves clear of the box and frictional resistance continues between the leg, the wedge, and the brake shoe.

Treated timber and the range of its uses underground was the theme of the exhibit by **Hickson's Timber Impregnation Co., Ltd.** As an example there was a mock-up of a steel arch supported roadway with cover boards, which have been vacuum-pressure impregnated with Pyrolith flame retardant preservative, set between the webs of the arches. Roadways so lagged have a smooth surface for good ventilation. Of more interest to metal-mining men are the company's Tanalith impregnated sleepers, timber props, and chocks for protection

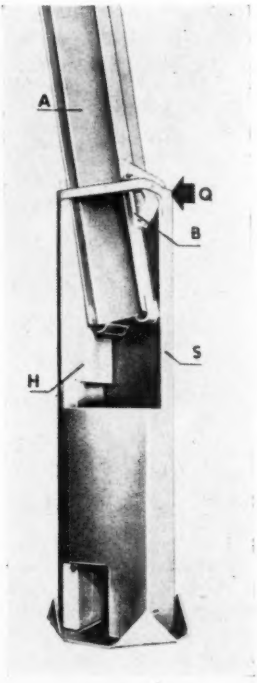


Fig. 2.

against fungi and insects. The humid conditions encountered underground result in untreated timber being liable to rapid decay from which fungus is established and "fruiting" follows which the ventilation system may cause to spread. The makers point out that untreated wood in mines can be completely decayed in under two years and that their wood preservatives have been used substantially in mines in many parts of the world, where they have proved their qualities for preserving underground timbers. There are "Tanalised" props still perfectly sound and still supporting the roof after 20 years.

Rock Drilling and Tools

Coal-cutting and rock-drilling tools with Wimet tungsten carbide inserts were shown by **Wickman, Ltd.,** who were also demonstrating for the first time their Erodosharp for the resharpening of bits by a new process described as an electro-erosion method. On this stand also was an example of a hand-held hammer drill made by Fried. Krupp Maschinenfabrik. This is a 44 lb. machine with an air consumption of 112 c.f.m. at 70 p.s.i. pressure.

Water-controlled hammer drills were to be seen on the stand of **Hardypick, Ltd.** These are a new design, in which the air supply is cut off if, for any reason, there is a failure in water supply. The various types offered include the Indomitable (48 lb.), the 60 pounder, and the Simplex B6B and RV.B6. A range of similarly operated pneumatic picks is also available.

A large-hole rotary percussive drilling machine—the Hausherr drill—was shown by **Dollery and Palmer, Ltd.** This machine is compressed-air operated and suitable for holes of 3⅛ in. to 4½ in. and for drilling at any angle and on various types of mountings to suit quarry conditions. The power unit is a 9-h.p. reversible air-vane motor and percussive unit with a 4-h.p. air motor for feed and retraction.

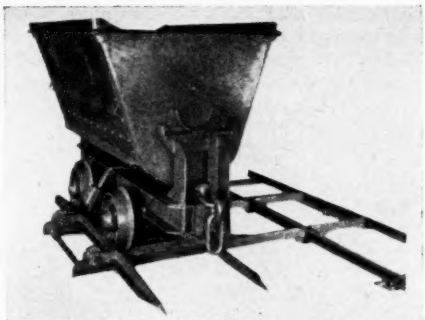
Hygiene and Safety

Included in the exhibit of **John Davis and Son (Derby), Ltd.,** who are well known as makers of a wide range of apparatus for underground duties, were a number of anemometers. These are available for air velocities from 30 to 6,000 f.p.m. and with extension and remote-control handles if required. A recent development, which was shown, is a telescopic rod with remote control to the instrument and a stop watch to give automatic synchronisation between the two, the whole being packed in a leather case for carrying.

For dust suppression on a conveyor system **Conflow, Ltd.,** were demonstrating their auto-spray control which is so devised that water spraying operates only on a loaded belt and is cut off when the belt is stopped or is only running empty. The company are makers of a number of types of valves for underground and surface duties as well as flow gauges and piping.

Light Railways

For narrow tunnelling schemes where single track operation is imposed a car transfer system was shown by **Robert Hudson, Ltd.** The illustration shows an



empty wagon mounted on the car transfer and side-stepped into a laybye. When ready to join a train the transfer can be rolled back on to the main track and the wagon coupled and moved off.

Belting Accessories

Belt lacing and belt cutting and squaring was demonstrated on the stand of **Mastabar Mining Equipment Co., Ltd.,** who were showing a range of their products marketed under the name Comet. Included in these, were the all-steel belt lacing machine with 15-ton jaw clench, a range of belt fasteners with Accronized rust-preventing coating, flame-resistant joint closure strip, flexible steel hinge pins, and a power operated lacer with slipping clutch in the transmission mechanism to protect the operator and capable of being driven direct from existing power supply systems.

Another company well-known for belt

lacing and repair equipment who were exhibiting is **Haydon-Nilos, Ltd.** They were showing their Zipper hand-operated belt-lacing machine which is light in weight and can be used by one man and is suitable for any thickness and width of belt. A power-driven machine for belt stitching and cutting was also shown which is suitable for rebuilding worn belting.

Winding

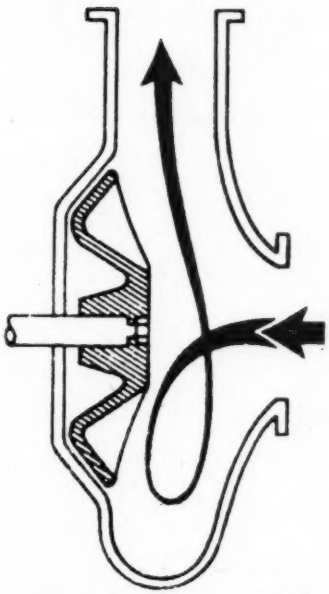
An impressive exhibit on the stand of **Markham and Co., Ltd.,** was a set of four 16-ft. deflector pulleys for a Koepe multiple rope tower winder, complete with shaft and bearings. This is an example of the company's heavy engineering products which include winding engines of various types.

Pumps and Pumping

Snore pumps for face drainage up to 50 g.p.m. at heads up to 150 ft. were to be seen on the stand of **Megator Pumps and Compressors, Ltd.,** who also featured the Dolphin floating suction strainer which was described in the MAGAZINE in March. A new float switch was demonstrated, in which a flat nylon belt instead of a wire rope is used which allows actuating stops or fingers that engage the switch trip lever to be mounted on the upper side of the belt and pass over the pulleys in operation.

To demonstrate the long snoring capabilities and quick self-priming characteristic of their design of pump was the purpose of the exhibit by **Mono Pumps, Ltd.** Its efficiency for handling slurries from settling ponds or for feeding filter presses and other similar applications was also featured.

A new pump shown for the first time in this country is the Wemco torque flow pump, the principle of which is patented by the Western Machinery Co. of San Francisco. It was exhibited by **West's Manchester, Ltd.,** who were also showing a Wemco laboratory dense-medium separator and a froth-flotation cell unit. The pump operates by creating a vortex effect, causing pulp in the main pump body to rotate, thus developing the suction and pressure heads necessary for pumping. This action is achieved by locating the impeller out of the main flow path so that the suction and discharge waterways become one continuous open passage. The solids are, therefore, drawn into the vortex by the swirling liquid and are discharged with a centrifugal sweep from the open chamber,



seldom touching the impeller, so that friable and easily damaged solids can be pumped successfully as well as highly abrasive pulps. The design thus avoids damage to solids being pumped and affords protection from excessive wear to the pump parts themselves. The pumps are available for capacities up to 2,500 g.p.m. and heads up to 120 ft.

Miscellaneous

By means of photographs of tunnels and shafts **Export and Technical Services (E.T.S., Ltd.)** called attention to large-hole boring machines for which they are as agents for the West German manufacturers. The tunnelling machine has a cross section of some 107½ sq. ft. and comprises cutting heads in three zones, side cutters, a driving mechanism with electric motors, suitable gearing and hydraulics, a spoil scraper, and a conveyor. It is hoped to give some further particulars in a subsequent issue.

A 4½-cu. yd. shuttle dumper suitable for operation underground was shown by **Aveling-Barford, Ltd.** For shaft descent the machine is in two parts to be assembled underground. A Dorman 4-cylinder engine of 66 b.h.p. or a Perkins 62·5 b.h.p. engine are available as alternative prime movers. The body of the dumper is specially reinforced for hard-rock handling.

Ore-Dressing Notes

(4) *Gravity Concentration.*

The Shaking Table (3)

Consideration now returns to preparation and presentation of feed to the table. Although screen-sized sands are occasionally treated, the normal—and correct—preparation is classification. This sorts the material into equal-settling fractions and the number of fractions made should accord with the maximum and minimum sized particle of *either* clean heavy mineral *or* clean light mineral which can be treated most efficiently in a given range of zizes. The object at this stage is to control the area, mass, and, above all, cross-section of the particles which are exposed to sluicing action. If the range is too wide sluicing force required to move the heaviest particle will be too violent to discriminate properly between middlings and tailings. If the range of sizes of the species for which the work is adjusted (*either* heavy *or* light) is too restricted the table will be too lightly fed to handle an economic working load. Here the use of trial-and-error adjustment when working a large sample is valuable, as shape factor also enters (hence area control of particle dimension so far as this is feasible or possible). Shape affects ability to teeter, occupy voids, cling, and overturn. The adjustments should be made with respect to one product only (preferably tailings or clean concentrate). If greater refinement is needed the flow-line can be adjusted to rougher-cleaner treatment. This also permits an increase in the range of particle sizes produced in each classified fraction. The roughing tables have as their primary task the rejection of barren tailings and their operation can, therefore, be simplified to two-product work (final rejected tail and retained values) or may be set to yield some final concentrate together with a strong intermediate band of middlings. This band goes to the cleaning tables for separation into two main bands (final concentrate and middlings for further treatment). A typical flow-sheet would follow the general lines of Fig. 1.

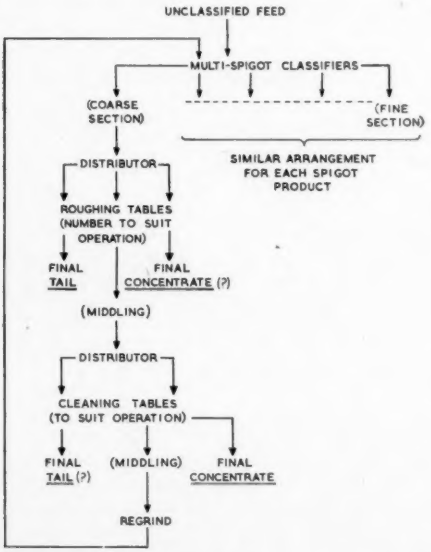


Fig. 1.

Provided the volume of sands treated is sufficient to justify this arrangement, several advantages are gained over the single-pass tabling system. A loading somewhere between one ton hourly for fine sands and two tons for moderately coarse material is commonly aimed at. The slimes section may handle about half a ton per table in cases such as cassiterite concentration, where loading must be kept low. With circulating load established a flow-sheet with three classifier splits handling ten tons of sands and one of slime per hour might have some such distribution, in the case of a 1/1 circulating load, as shown in Fig. 2. The merit of this type of flow-sheet lies partly in the flexibility it makes available, particularly when a mineral is to be concentrated by all-gravity methods. The larger the return new feed ration, the more gently can regrinding be performed. This is analogous to improvement of grinding efficiency by increasing the circulating load in closed-circuit ball milling, but has added advantages. By reducing particle size gently, a maximum liberation at the coarsest practicable mesh is achieved. This, by allowing the tables to treat coarser sands, increases their duty and their efficiency of recovery. Less slimes are made since over-grinding is reduced and this again improves both recovery and grade. Since the tables are set for virtually two-product treatment they require less skilled attendance than when band-wander in three-band separation is in use. At the same time band-wander is reduced because the tables are more steadily fed under return-load

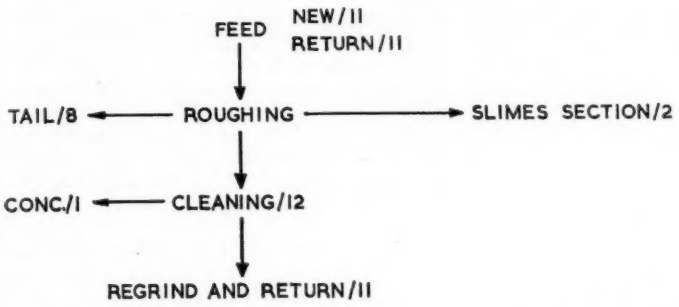


Fig. 2.

working than under single-pass conditions. The reason for this is that the bulk of the barren sand is removed on its first arrival in the roughing section. When the plant has worked up to load this leads to a much larger middlings band coming back from the cleaner regrind. This band, moreover, is reasonably consistent in its response to both classification and roughing. With one-pass treatment a slight change in ore texture calls for several trimming adjustments and these require highly skilled co-ordination between the shiftsmen. With a big middlings recirculation fluctuations in the feed are taken up without the need for close or skilled attention.

E. J. P.

(5) *Filtration.*

The paper by D. A. Dahlstrom read at the Vancouver annual general meeting of the Canadian Institute in April, 1958, on " The Application of Continuous Filters in the Metalliferous Flow-Sheet " is reprinted in the February, 1959, *Bulletin*. The author designates four essential rate functions as :—

(1) Filter cake formation rate ;
(2) de-watering rate of filter cake ;
(3) rate of recovery of soluble salts, and
(4) rate of drying of filter cake by thermal methods.

The first two of these are always present, but the last-named two are not necessarily met in the mill problem. The purpose of the paper is to describe the methods of laboratory testing which can lead to the scaling up from the results they show. Laboratory filter-cake testing is an extremely complicated business in which a great number of variables are encountered. The paper is of considerable value to the specialist in that it opens up this subject in a comprehensive manner. Final selection of treatment must bring into consideration some or all of these factors :—

(1) Method of picking up cake ;
(2) average solid-liquid ratio in the feed ;
(3) size distribution of solids in the feed ;
(4) cake formation time as a percentage of the filter cycle ;
(5) cake drying time as a percentage of the filter cycle, and
(6) cake washing time as a percentage of the filter cycle.

The author's first point is that there should be a homogeneous filter cake covering the entire surface of the membrane. Only thus can the best be made of the four rate functions above noted. Filters which draw their cake from the slurry against gravity are used for feeds with only mild settling tendencies. In such pulps the solids remain in suspension with relatively low-speed agitation. There is, therefore, a limit to the top size of particle which should be fed to such a system. There is, however, no limit to the minimum size. Filters which use the force of gravity to help them in forming their cake include materials which filter rapidly or which have little tendency to settle so that there is practically no solid stratification. Here there is usually no limitation of the top size, but extreme fines should be kept to the minimum, particularly slimes. Filters working against gravity have the highest percentage of cake formation time, while those being aided by gravity have the maximum percentage range for cake dewatering.

Dahlstrom goes on to describe testing procedures using fairly simple bench scale methods. These can be made to duplicate the full filter cycle. He lists 25 factors which should be determined during these tests. These include the formation, dewatering, and watering time for the cake and the effect of pressure drop during cake formation, washing, and dewatering. Temperature, kind of filter media, cake moisture content, agitation,

solid-liquid ratio of feed, clarity of filtrate, and use of filter aids are among other points surveyed. The usual bench-scale test is made on a filter bed 0·1 of a square foot in area with a drainage pattern similar to that of a full-scale unit. Vacuum or pressure is supplied to this and the filter media is placed on by a simple method. Feed samples should come from a full-scale plant or from a pilot plant which is believed to be simulating the conditions that will obtain in full practice. Fresh material is highly desirable as various changes occur in clays and slimes, colloids, and organic solids with the passage of time.

The bulk of the paper is concerned with the elucidation and mathematical treatment of the information obtainable from tests.

Engineering Log

The June issue of the Bank of Nova Scotia's " Monthly Review " draws attention to the fact that 15 years ago Ungava-Labrador was a remote and largely unknown region. Today, it says, the frontier is being pushed back and the area is being drawn into the orbit of the economy. Development is on a grand scale, of necessity, since only the promise of a large volume of output could justify the costs involved in bringing into production resources located in such remote and inhospitable country. In the past ten years the development of the iron-ore deposits at Knob Lake has led to the construction of a railway line from the shores of the St. Lawrence 360 miles north and the building of a new town, Schefferville, in the interior. This first opening up of the interior is now being followed by other large-scale developments again based on iron ore. By the mid-1960's iron-ore shipments from the projects now operating or reasonably certain to be developed could well exceed 30,000,000 tons, the Review points out. Another rich endowment of Ungava-Labrador is its enormous water-power resources, still largely untapped. One of the biggest remaining undeveloped power sites in Canada is at Grand Falls on the Hamilton River. Surveys have indicated that 4,000,000 h.p. could be developed there at a single site, while in almost any part of the interior new mining projects will find convenient locations for power plants. In this connexion the availability of surplus power on the Manicouagan River and the location of Baie Comeau at tidewater were important factors in attracting the aluminium industry. The past year has seen the completion of a smelter with an initial capacity of 90,000 tons—to be doubled eventually. With the opening of the Seaway this year the St. Lawrence River becomes an even more important transportation link for the North Shore and the mining projects in the interior.

* * *

In preparation for the foreseeable exhaustion of the earth's supply of uranium 235 the Argonne National Laboratory has set up a new plant for the fabrication of plutonium and work on the development of plutonium fuel elements for reactors is already under way. The development of usable plutonium fuel elements is, however, accompanied by problems of a peculiarly formidable nature. Plutonium is a metal which is known to assume at least six crystal forms. Between room temperature and its melting point at 640° Centigrade it passes hrough five solid state transformations, each of these drastic changes being characterized by a change in volume and in the physical properties of the metal. Fuel elements of plutonium would be subject to the same twisting and buckling as the metal itself would undergo as the temperature rose and fell during operation. Another point of importance is that the metal is very dangerous. Dust, turnings, hydrides, some alloys, and impure residues of plutonium are pyrophoric and subject to spontaneous combustion. Ignited, these forms of the metal give off radioactive plutonium oxide smoke, which is lethal. Plutonium is an intense alpha-particle emitter and no smoke nor any of the dust of the metal may be permitted to escape into the atmosphere, where it might be inhaled or ingested by human beings. These problems and others like them have been solved in the new Argonne plant. A miniature rolling-mill has been designed to handle soap-in bar sized ingots of plutonium and all the machinery is totally enclosed in glass, operating in an inert helium atmosphere. Most operations are handled remotely or automatically, so that the need for handling the material is reduced to a minimum. During milling and fabricating processes, however, human intervention is possible at some stages by the provision of 1,500 sealed portholes fitted with sleeve-length neoprene gloves. Over a hundred fume hoods are used to filter plutonium dust from the system.[1]

[1] *Scientific American*, July, 1959.

The U.S. Patent Office has granted a patent on the invention of Estane VC to the B. F. Goodrich Company. This new material is tough, resilient, and resistant to tearing, abrasion, oil, and ozone, unlike the usual rubbery materials, according to the makers. A type of plastic, it snaps like rubber, but unlike rubber needs no vulcanization. The most unusual of the many uses already found for it is in the development of plastic hearts and heart valves. It is most valuable in this application; tough, resilient, flexible, free from additive to leach out, stable in blood and plasma, and acceptable to the heart tissue, so that not only the heart itself but valves too and artery grafts can be made from it. There are many other likely uses, including fuel hose, small-bore tubing, belting, coated fabrics, linings, mounts, diaphragms, pump components, and insulators.[1]

* * *

It is necessary in a wide variety of industrial processes to exclude dust from a working area. A simple new process uses a novel "dust barrier screen", consisting of an open-weave material impregnated with a non-drying adhesive. This may be stretched across windows or ventilating ducts, or erected on a light framework to enclose a working area. It arrests dust, while not impeding light or ventilation to any appreciable extent. Floor coverings and door mats of similar material are available to clean the shoes of staff entering a protected area and to trap settling dust.[2]

* * *

At the Agricultural Research Council's experimental station at Rothamsted, near London, a newly-constructed mechanical "cow" has just begun work. The natural cow is a very inefficient machine for the conversion of protein in grass to milk and beef protein, averaging an efficiency rating of about 5%, so that 95% of the grass protein goes to waste. A nutrition expert at the station points out that in many areas of the world there is malnutrition caused by a protein-deficient diet and this malnutrition may exist even when hunger itself is satisfied. For these areas a mechanical cow, capable of performing the function of the natural cow which chews vegetation and produces protein in the form of beef when it is slaughtered, but without the natural cow's 95% efficiency loss, could be of great value. Accordingly the mechanical cow has been built. Its function is to extract protein from grass, leaves, and any other suitable vegetation. An elevator feeds the machine with greenstuff. The fodder is then chopped and enters a press where the juice is squeezed out. This juice contains the concentration of the protein in the greenstuff and scarcely any cellulose. The protein is then precipitated by steam treatment of the juice. A filter next separates the superfluous juice from the solid protein. This waste juice and the dry chopped fodder from which it has been extracted are still serviceable for feeding to stock. In the meantime the mechanical cow has extracted, within a few minutes, a minimum of 50% of the protein content in solid cake form. From Rothamsted the protein cake travels to the Rowlett Research Institute, Aberdeen, where it is being fed experimentally to pigs. These animals have a digestive system similar to man's and are fed protein in place of fish meal. Last year the experiment was on a small scale and the pigs did much better than on normal feed. This year mechanical cow protein feeding is at full scale and should give a reliable indication of whether this experiment is one which will be of permanent value to mankind and of immediate benefit to ill-nourished peoples living in the under-developed areas of the world.[1]

* * *

Spurred by intense interest throughout industry in the control of vibration in buildings and machinery, the Lead Industries Association in the United States has just initiated an extensive research project to develop engineering data on the use of lead for this purpose. Combination lead-asbestos pads have been used for many years to prevent transmission of vibration from railway tracks to buildings, while machinery has also often been installed on such pads to prevent vibration. However, past applications have been based primarily on experience and empirical methods, since few engineering data have been available to guide the engineer. It is intended to develop these data systematically through the new research project, which will be conducted under contract by Lessells and Associates, Inc., of Boston, who have been prominent in research on vibration for many years.

[1] *Comp. Air Mag.*, June, 1959.
[2] *Metal Finishing Journal*, Aug., 1958.

[1] *Science News Letter*, June 20, 1959.

News Letters

BRITISH COLUMBIA

July 3.

Transcontinental Resources, Ltd.—The annual report of Transcontinental Resources for 1958 shows the company's cash and quick-asset position in major associated and controlled companies to have been well maintained. A limited amount of exploration and prospecting was undertaken during the year; an asbestos prospect having been acquired in north-western British Columbia, while development was continued on the Arizona copper property which was under option to American interests. Transator Explorations, Ltd., in which Transcontinental holds a 50% interest, turned over its Mattagami property to Lynx Yellowknife Gold Mines, Ltd. and the latter company is proceeding with exploration and development. Recently Transcontinental bought a neighbouring property to Lardeau Sunshine Mines, with a substantial developed tonnage of high-grade gold-silver-lead-zinc ore. Sunshine itself is to be operated as an investment company.

Skeena.—Expenditures on exploration and shut-down expense were responsible for a slight decrease in working capital of Silver Standard Mines, Ltd. to $558,583 during the year ended March 31 last. Silver Standard has been greatly encouraged by the drilling of its iron properties at Harriet Harbour on Moresby Island. Mr. Ridgeway W. Wilson, the company president, states: "Investigation of the Japanese market for iron ore shows it to be good at this time with every indication of future improvement. The properties are ideally situated close to tidewater and a suitable barbour of apparent good grade, mineable the year round, with low-cost open-pit methods indicated."

Alberni.—The Consolidated Mining and Smelting Co. of Canada, has entered into an agreement with the Empire Development Co., Ltd. and will proceed with investigation of the Quatsino property in the search for copper orebodies. The property is the 50-claim group of Quatsino Copper-Gold Mines, which was assigned to Empire on a 50-year lease when the latter company was formed to mine and concentrate iron ore for export to Japan. Cominco's Coast Copper property adjoins the Quatsino holdings to the north.

Highland Valley.—A discovery of better-grade copper ore has been made by Bethlehem Copper Corporation in the Huestis zone, 2,000 ft. south-east of the portal of the present adit, driven to explore the Jersey and East Jersey zones and some 900 ft. due south of that adit at a point 1,700 ft. from the portal. At the annual meeting on June 19 Mr. H. H. Huestis, the company president, was confident that the Bethlehem development would support a smelter and a refinery and, at the worst, would be a certain producer of copper. Directors are convinced ore reserves would be at least 50,000,000 tons grading between 0·9% and 1·0% copper and would be recoverable by open-pit mining methods.

Nicola.—Vimy Explorations Ltd. is pressing a vigorous exploration programme on its 24-claim copper prospect, adjoining the Torwest Resources' Aberdeen property on the north. Some high-grade ore has been shipped from the property by former operators.

Golden.—In a release in advance of the annual report for the year ended May 31 last Sheep Creek Mines shows a net profit of $219,857 after all charges. Extraction from the mine at Invermere was 189,833 tons of ore containing 2·36% lead and 5·45% zinc and 937 tons of barite ore. Production consisted of 5,904 tons of lead concentrate. Mr. H. E. Doelle, the managing director, reports: "The eventual result of the U.S. restrictions on imports of zinc and lead is unknown. The improved business conditions have led to some increased purchasing. A general agreement by Canadian zinc producers has led to a voluntary reduction of production. Your company produced 15·3% less zinc during the second half of the fiscal year."

Yukon.—Canadian Creek Placers, Ltd., is preparing its placer leases on Canadian Creek, a tributary of the Yukon River about 90 miles south-east of Dawson, for dredging this season. A limited reserve has been established with grade varying from $1 to $3·20 per cu. yd.

EASTERN CANADA

July 21.

Gold Production.—The output of the gold mines of Ontario for April included 225,027 oz. of gold and 21,778 oz. of silver, valued at $7,612,554, from 776,583 tons of ore milled.

Quebec.—In January Quebec mines produced 83,118 oz. of gold and 359,859 oz. of silver. Asbestos shipments for the month totalled 50,661 tons.

It is reported that the Iron Ore Company of Canada is to build an ore processing mill in the Carol Lake area of Labrador at an estimated cost of $75,000,000. At the same time the Wabush Iron Company is speeding up operations at Wabush Lake and is constructing a pilot beneficiation plant.

FAR EAST

July 10.

Singapore.—The quantity of imports and exports of oil handled in Singapore has risen in 10 years from 1,500,000 tons in 1947 to more than 10,000,000 tons in 1957. During the last-named year more than 1,000,000 tons of fuel oil were delivered over the wharves and a similar quantity was delivered to ships in Singapore harbour. Singapore, with its installations on islands a few miles off its shores, was the main distributing centre for petroleum products in South-east Asia. It was also the base of a large tanker fleet.

A report covering production in the Federation in 1957 states that the bulk of the tin-ore smelted at Pulau Brani, an island in Singapore harbour, was mined in the Federation of Malaya. The Straits Trading Company's second smelter at Butterworth now treated part of the ore formerly sent to Singapore.

Borneo.—A geochemical search for copper in North Borneo is to be intensified. Geological mapping is now in hand in the lower Labuk area, which reconnaissance surveys have shown to be worth searching for copper minerals and chromite.

Sarawak's bauxite industry is now yielding useful revenue; last year 100,000 tons worth about (Malayan) $1,800,000 was exported. The amount should be doubled this year and already a stockpile of about 60,000 tons of ore was awaiting shipment to Sematan.

Ceylon.—Russian experts are to draw up a detailed project report, expected to be ready by early 1960, for a steel mill which is to be built in Ceylon. All the equipment needed will be ordered from Russia. Present plans are to erect an integrated iron and steel works in three stages.

Pakistan.—Samples of Sehwan clay have been sent for examination to the Pakistan Council of Scientific and Industrial Research in Karachi, with a view to setting up a chinaware and sanitary-ware factory.

While drilling was for petroleum, large deposits of hot concentrated brine have been discovered at Dhariala, in the Jhelum district. The brine occurs under high pressure and is capable of flowing at 60,000 gallons per hour.

A team from the U.S.A. was recently in Karachi to explore the possibilities of the export of gas from Pakistan. The aim was to find out if the natural gas found in Pakistan could be liquified on a commercial basis.

A natural gas fertilizer factory is to be set up at Fenchuganj by the Pakistan Industrial Development Corporation. It will produce 250,000 tons of ammonium sulphate per year. The project will cost about Rs. 160,000,000.

India.—An oil development programme costing Rs. 4,000,000,000 has been prepared by the Indian Government's Oil and Natural Gas Commission for the next five-year plan. This envisages the exploration, refining, and marketing of 10,000,000 tons of oil a year by 1967. To achieve this production between 40 and 45 additional drills would, it is expected, be needed, as well as several more refineries. The Tiruchirapalli area, in Madras State, has been described by West German experts as a region of " medium oil possibilities." The Germans toured various parts of India to study oil potential in the country.

Large reserves of graphite have been traced in the Baramullah district of Kashmir, it is reported. The Geological Survey has recommended that the preliminary investigation should be extended to the other deposits in the area.

AUSTRALIA

July 20.

Mount Isa Mines.—Mount Isa is to sink a new ore shaft which will hoist 800 tons of ore per hour from a depth of 3,000 ft.—*i.e.*, twice the capacity of the present ore shaft. It is expected that the work will be completed in about 5 years. The new shaft will be steel and concrete and, with the existing timbered shaft, will give a combined maximum haulage capacity of 20,000 tons of ore per day. The shaft will cope comfortably with the planned output of 14,400 tons of ore per day.

The first furnace in the copper refinery at Townsville, has been lighted up. It is expected that the initial production of wire bars will be made from this furnace in August or September. Early next year it is expected that the rolling plant will be put into commission. Outlay on the refinery to date is about £A3,500,000 and the completion of the rod mill and wire drawing plant will increase the capital cost by a further £A1,000,000. Other expansion to the plant is planned for completion in two years' time at an additional cost of £A1,000,000.

Copper in Western Australia.—Diamond drilling in the abandoned Phillips River copper field, at Ravensthorpe, primarily prospecting for uranium, located extensions of the Elverdton copper lode, which, in view of the then prevailing price for copper, appeared to warrant thorough investigation. Following extension of the diamond drilling a mill was erected to treat the existing mullock dumps and, since its completion, a steady but moderate production of copper concentrate has been maintained. It is now reported that approaches have been made to Japanese mining interests to invest in the undertaking so as to obtain a supply of copper concentrates on a long-term basis. At present the mine is supplying about 6,000 tons of concentrates per year to Japan.

Queensland Coal.—The Collinsville area is the most important of Queensland's northern coalfields. The principal colliery is State owned, but Mount Isa Mines, Ltd., has been developing a coal mine to supply the requirements of the Mount Isa mines ; this mine will be highly mechanized and will be an outstanding undertaking.

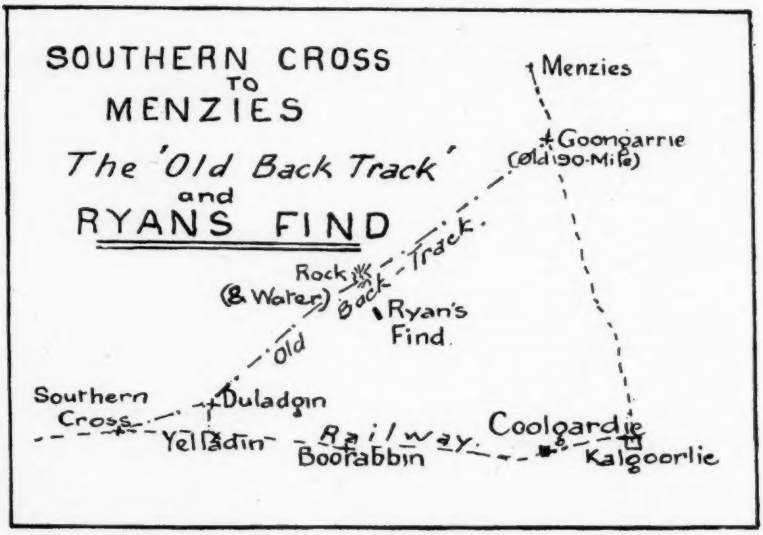
Industrial.—The Commonwealth Arbitration Commission has fixed a new basic wage at 15s. per week higher than that previously in force. The effect of this award is, in general, an increase from £7 2s. per week in November, 1950, to the present figure of £13 16s. per week. The unions also applied for the restoration of the quarterly adjustment of the basic wage which was discontinued in 1953, but this was refused. The industrial position has been further threatened by the action of the Premier of New South Wales in removing penalty clauses from the State industrial awards, thus giving the right to strike. At the same time employees in State-owned coal mines were granted a 37½-hour week in place of the previously existing 40-hour week, so that the way is now open for all unions to petition the Industrial Courts for variations in their awards to 37½ hours per week standard in all industries.

Uranium Production.—Production of uranium oxide by United Uranium, N.L., in the Northern Territory, is reported to be exceeding expectations. The mill, which is situated near Pine Creek, has recently commenced operations and in the four weeks to June 16, produced uranium oxide to the value of £A102,069.

Mount Morgan.—Mount Morgan, Ltd. plans to utilize the pyrite content of its ore and counter the loss of the hoped-for stimulus to sales of pyrite concentrate resulting from the unfavourable Government attitude to increased bounty to encourage the use of pyrite instead of imported brimstone for acid manufacture. The company is to seek capital overseas for the erection of a nitrogenous fertilizer plant at an estimated cost of £A6,000,000. The proposed industry would be established at Mount Morgan, where, in addition to large supplies of pyrite, ample coal is available from the company's colliery.

Western Australian Gold.—The State has made strong representations to the Commonwealth Government for adequate assistance to the gold-mining industry. The request for the renewal of the Gold Mining Industries Assistance Act was granted and the terms of assistance were liberalized, but consideration of other requests did not meet the approval of the industry. The Federal Government Members Mining Committee has visited the State and the Federal Treasurer has been asked to make a visit himself, to see personally what is the importance of the industry, its value to the State, and its

New Gold Discovery



bearing upon employment, and the population of the inland areas.

Two well-known prospectors, Messrs. Walls and Voumard, with another (Edwards) reported recently a find of gold in the " Ryans Find " area 30 miles north of Boorabbin. The method of loaming brought the men in July on to the site to sink and 4 cwt. of decomposed schist containing finely divided gold yielded 188 oz., worth £A3,000. The " pipe " is still auriferous at 15 ft. depth and likely to continue deeper.

Very little work has been done in this area for some years. " The Old Track " was in use in the 90's to Goongarrie and Menzies but little used after completion of the railways. At the Rocks is the nearest available water supply, while at Duladgin there is the grave of one Thomas Davidson, Glasgow, who died in 1896.

SOUTHERN AFRICA

July 28.

General.—A trade mission consisting of representatives of the Transvaal Coal Owners' Association, Natal Associated Collieries (and the Natal coke producers) and to be accompanied by a Southern Rhodesian delegate from Wankie Collieries, is shortly to visit South America in an attempt to establish a market there for Southern African output. The South African interest is confined mainly to the sale of coal, while the Wankie representative will be interested mainly in sales of coking coal. The Central African Federation, unlike the Union, has available for export large quantities of such coal. In particular, Argentine, Uruguay, and Brazil will be visited. Keen competition is expected to be encouraged and may mean reduction of prices even below those obtainable within Southern Africa, aggravated by high transport charges arising from the lack of trade reciprocity. This means that ships engaged in the potential trade will have to carry ballast on the return leg of the voyage. This mission represents part of the programme which the coal industry has embarked upon to re-establish export markets for its surplus output.

A movement is now getting into its stride to raise living standards and wages of the lower income groups in South African industry, especially for unskilled labour and non-Europeans. The engineering industry has already announced wage increases for such groups. This industry embraces iron, steel, engineering, and metallurgical enterprises.

All universities in South Africa have now been authorized to acquire radioactive material other than from the Atomic Energy Board up to an overall stock of not more than 2 kg. of each particular material, for training and/or research purposes.

An agreement has been reached between the South African Railways and S.A. Manganese, Ltd., whereunder the former will construct and operate an extension of the rail-line from the present railhead at Sishen to a new terminal point at Hotazel, in the district of Kuruman, a distance of about 40·25 miles, at a cost of about £1,232,000,000. The agreement is subject to ratification by Parliament. Manganese and iron ores will be the main traffic carried on the extension.

According to the review of the S.A. Reserve Bank, and in the light of indices for the major components of the country's economy, there was a noticeable improvement in conditions in April and May compared with the first quarter and the second half of 1958. Both imports and exports rose in value and there was a further improvement in the balance of payments.

Transvaal.—Mineral Holdings, Ltd.—a subsidiary of Henderson's Transvaal Estates, Ltd.—sold, as reported previously, its mineral rights over the farm Zandfontein in the Kinross area to the Union Corporation group. Should this farm be included in the area from which two mining leases will be formed, Mineral Holdings will participate in providing the initial working capital.

South West Africa.—Oil prospecting is scheduled to be started in the immediate future by Trans-American Mining Corporation, Ltd., in the concession ceded to it by Diamond Mining and Utility Co. (S.W.A.), Ltd., for the consideration of an 8% royalty on gross earnings. The concession extends from north of Lureitz to Conception Bay.

Central African Federation.—Bancroft Mines, Ltd., which initiated copper production on April 1 this year, had a finished copper output of 12,166 long tons of blister. The scheduled output rate is 50,000 long tons per annum, which, unless the mill grade be reduced, should be exceeded in practice subject to cut-backs in production. The milling and treatment rate in the second quarter averaged nearly 135,560 tons of ore monthly, compared with the projected rate of 150,000 tons monthly which should be reached in the last quarter of the current year. Pumping is materially lowering the water-table in the mine.

EASTERN CANADA

July 27.

Gold Production.—The gold mines of Ontario in April produced 225,027 oz. of gold and 32,778 oz. of silver, valued at $7,612,554, from 776,583 tons of ore milled. In May the 791,199 tons treated yielded 227,924 oz. of gold and 34,006 oz. of silver, worth $7,713,970.

Geology of the U.S.S.R.

The recent publication of a large number of works descriptive of the geology and tectonics of the U.S.S.R. merits some comment. As recently as five years ago the western geologist interested in global problems found considerable difficulty in obtaining information on the general geology of the Soviet Union, there being no simple text-book, either in Russian or in any other language, readily available to him. But a marked amelioration in the westward flow of literature on the earth sciences has been experienced since the meetings of the International Geological Congress in Mexico City in 1956. At these meetings several new maps of the U.S.S.R. were presented, notably geological maps on the scale 1 : 2,500,000 and 1 : 5,000,000 and a tectonic map on the scale 1 : 5,000,000 and copies of these have recently been obtainable through commercial channels. Explanatory handbooks to the maps have since been published and translations of these works into western languages are now beginning to appear. To accompany the tectonic map of the U.S.S.R. and neighbouring countries, prepared under the editorship of Academician Shatsky and Dr. Bogdanov (1), a short explanatory brochure was published in 1957 (2), this providing a readable but succinct account of the general geology of the sub-continent. An English translation of this work occupies half of the first number of the new periodical *International Geology Review*, issued monthly from January, 1959, by the American Geological Institute (3). It is proposed that this new journal will be occupied by translations, principally from Russian literature. Simultaneously, the Deutschen Akademie der Wissenschaften zu Berlin has begun to publish a new serial entitled *Fortschritte der Sowjetischen Geologie* (4), of which the first number is taken up by a translation into German of the same Russian work.

It is of interest to note that a Commission of the International Geological Congress, with Shatsky as chairman and Bogdanov as secretary, has undertaken to compile similar tectonic maps of Europe (1 : 2,500,000) and of the world (1 : 5,000,000) and that in 1957 the Academy of Sciences of the U.S.S.R. voted funds establishing a Laboratory for Tectonic Maps to facilitate this work. (In a recent report this laboratory has transported British Columbia to South America !) The map of Europe is scheduled for completion in 1960.

The recent geological maps of the U.S.S.R. have appeared on two scales, 1 : 2,500,000 comprising 19 sheets and 1 : 5,000,000 in 9 sheets, both including index sheets (5, 6). A separate index sheet in English is available for the smaller scale. Both maps are handsome productions. An accompanying text by Academician Nalivkin (7), who edited the maps, gives " A brief sketch of the geology of the U.S.S.R.," reviewing the stratigraphy, tectonics, magmatism, and mineral deposits on a regional basis. An English translation of this text is in course of production for a commercial publishing house.

Finally, reference must be made to a much more lengthy work entitled *The Geological Structure of the U.S.S.R.*, written by more than 150 authors under the direction of Academician Markovsky and published last year in four large volumes (8). From this text it is possible for the first time to obtain a balanced account of the rock formations of any geological age in any region of the U.S.S.R. The first volume deals with geomorphology and stratigraphy, the second with magmatism and volcanicity, the third is concerned with regional and continental tectonics, and the fourth is a portfolio containing a 1 : 7,500,000 map in two sheets,

well printed in 80 colours. The immense task of preparing a western translation of this highly important work has been shouldered by M. Pietresson de Saint-Aubin and M. J. Roger of the Centre National de la Recherche Scientifique in Paris, who have already produced the first of 20 or more fascicules in French (9). The funds for all these translations have been provided by Government agencies. In America finance has been forthcoming from the National Science Foundation, in France from the Centre National de la Recherche Scientifique, in East Germany from the Staatlichen Geologischen Kommission. In Britain it seems that official action on the pressing problem of keeping pace with Russian geological literature has not yet progressed beyond the committee table. C. F. D.

References

(1) *Tektonicheskaya karta SSSR i sopredelnykh stran.* 1 : 5,000,000. 9 sheets. Gosgeoltekhizdat, Moscow, 1956. Price 46 r.

(2) *Tektonicheskaya karta SSSR v masshtabe 1 : 5,000,000 : Obyasnitelnaya Zapiska.* Gosgeoltekhizdat, Moscow, 1957. 79 pp. + map. Price 2 r. 70 k.

(3) SHATZKI, N. S., and BOGDANOW, A. A., "Tectonic map of the U.S.S.R.: explanatory notes." *International Geology Review*, vol. i, pp. 1–49, 1959.

(4) SCHATSKI, N. S., and BOGDANOW, A. A., "Grundzuge der tektonischen Baues der Sowjetunion." *Fortschritte der Sowjetischen Geologie*, Akademie-Verlag, Berlin, 1959. 84 pp. + map. Price DM 8·50.

(5) *Geologicheskaya karta SSSR. 1 : 5,000,000.* 8 sheets + 2 indexes. Gosgeoltekhizdat, Moscow, 1955. Price 45 r.

(6) *Geologicheskaya karta SSSR. 1 : 2,500,000.* 18 sheets + index. Gosgeoltekhizdat, Moscow, 1955. Price 140 r.

(7) NALIVKIN, D. V., *Kratkii ocherk geologii SSSR.* Gosgeoltekhizdat, Moscow, 1957. 144 pp. Price 4 r. 55 k.

(8) *Géologicheskoe stroenie SSSR.* Editor-in-chief, A. P. Markovskii. Vol. i, Stratigraphy, 588 pp., 14 folding tables; vol. ii, Magmatism, 332 pp., 7 folding tables; vol. iii, Tectonics, 384 pp., 27 folding maps; vol. iv, coloured geol. map of U.S.S.R. 1 : 7,500,000, with geomorphological map 1 : 15,000,000. Gosgeoltekhizdat, Moscow, 1958. Price 108 r.

(9) *Structure géologique de l'U.R.S.S.* Centre National de la Recherche Scientifique, Paris, 1959

→.n.p.

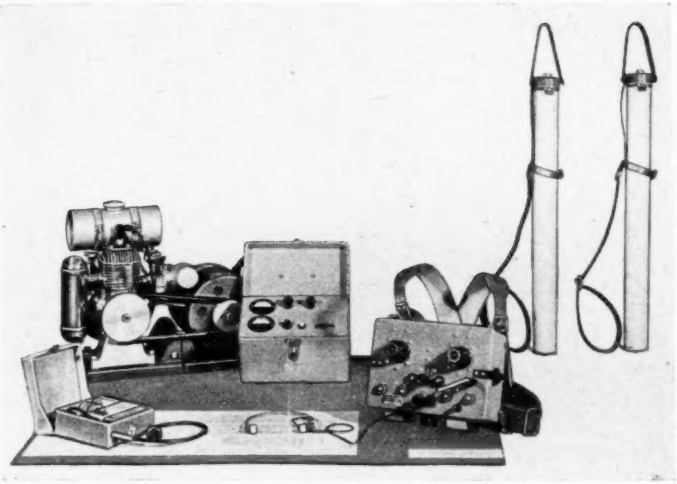
Trade Notes

Brief descriptions of developments of interest to the mining engineer

Electromagnetic Ground Prospecting Equipment

Some particulars have recently been made available of equipment for ore prospecting by electromagnetic inductive methods by **AB Elektrisk Malmletning** (ABEM Co.), of Danderydsgatan 11, Stockholm, known as the Turam 25, it is described by the makers as the latest step in the development of the programme they have had in hand since this method was first introduced to mining geophysics in 1932. The equipment, which is shown in the illustration, comprises a generator set, a compensator-amplifier unit, receiver staffs, connecting cables, headphones, and sundry accessories including carrying equipment.

The generator set consists of a petrol engine and two-frequency a.c. generator mounted on light metal base plates. The compensator consists of a bridge arrangement to which the two staffs are connected. When measuring, the two dials are adjusted so that no signal is heard in the headset; the amplitude ratio and the phase difference between the voltages induced in the two receiver staffs are then read directly from two scales. The compensator can take in phase differences from + 21° to — 21° and all possible amplitude ratios. The amplitude ratio can be determined to better than 1% within the normal range 0·5–2·0; the phase difference is measured as close as 0·1°. To amplify the small voltages in the bridge circuit a battery-operated five-stage amplifier



Prospecting Equipment

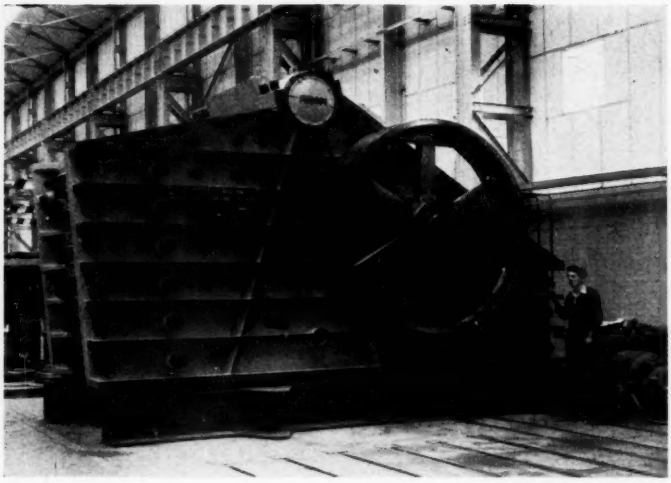
is coupled to the compensator *via* a symmetric input transformer. The amplifier batteries, three standard 1·5 V. cells and one 67·5 V. B-battery, last for about three weeks of normal field work. The compensator and amplifier are housed together in a watertight metal cabinet with the operating controls grouped on the front face. This cabinet is hooked on to and carried by a leather harness which also carries the small amplifier battery box and one of the receiver staffs.

The two receiver staffs are integral parts of the compensator circuit and have identical inductance and resistance values. Each consists of a ferrite core with windings for the two frequencies, 660 and 220 cps. The windings and cores are shielded and hermetically sealed in strong plastic casings; these casings carry the fittings for the cable connexions. An inclinometer can be attached to one of the staffs for measurements of the field inclination. The staffs have leather carrying straps for attachment to the belts of the leather harness, or for slinging over the shoulder when moving between observation points. One extra staff is supplied as standard. The connecting cables are shielded rubber-covered four-conductor cables with contacts at both ends. Lengths of 2, 22, and 42 metres are supplied and the cable may be used as a measuring tape when surveying over unstaked ground. For satisfactory results the primary cable should be of insulated stranded single conductor type with a minimum conducting area of 1 mm.^{2}, good insulation for 1,000 V. minimum, and sufficient flexibility for easy handling. This can be supplied on request together with suitable cable drums.

The company's leaflet describing this equipment explains the method of use for the detection of geological anomalies in accordance with the usual practice.

Roller-Bearing Primary Jaw-Crusher

Last month **Pegson, Ltd.**, of Coalville, Leicestershire, afforded an opportunity of seeing a 60 in. by 48 in. double-toggle crusher under test in their new works extension. Illustrated here, the machine, which weighs approximately 120 tons and stands 11-ft. high by 20-ft. long by 12-ft. wide, is capable of high duty and has a capacity range of 300 to 500 tons per hour, according to the nature of the material being handled and the discharge setting required; settings can be varied from 8 in. to 12 in. The wide mouth, it is suggested, enables larger feed sizes to be conveyed directly into the crusher and so economizes on the re-blasting of material from its quarried or mined state. Particular features of the machine on view, destined for a quarry in this country, are its exceptional strength with roller-bearing design, a hydraulic mechanism which gives speedy and easy adjustment of the jaw setting, a special shear-type toggle plate that fractures in an



Pegson

Jaw-Crusher

emergency, and down-thrust toggle seats which decrease the bearing load and require no lubrication.

The company is convinced that increased demands on the quarry and metalliferous mining industries and the necessity to obtain high outputs per man-hour of quarry or mine cost at the primary crushing station have created a demand for high-capacity primary crushers capable of handling large feed sizes. It is to meet this requirement that they are now adding to their extensive range of crushing equipment a number of mammoth-size crushers of which the machine on view is the largest to date. A second crusher of the same type now moving through the shop has been ordered by Humphreys and Glasgow for an operation in Australia.

Personal

W. J. BATH is now in Northern Rhodesia.

H. F. BROWN is home from Ghana.

B. G. DALE is now in Kenya.

M. J. GREER is home from Malaya.

W. D. HARVERSON has now taken up his duties as Commissioner for Mines, Tanganyika, in succession to V. T. HOCKIN, who has retired.

R. HUTCHINSON is now in Canada.

H. D. M. JAGER, formerly general superintendent of the Pioneer division, Bralorne-Pioneer Mines, Ltd., British Columbia, has returned to England.

C. LEIGH, H.M. Senior District Inspector of Mines and Quarries in South Wales, has been appointed H.M. Divisional Inspector of Mines and Quarries for the South-Western Division, with headquarters at Cardiff.

R. F. LETHBRIDGE has been appointed a director of the Compañia Española de Minas de Rio Tinto S.A., in succession to the late Mr. L. C. HILL.

C. H. W. MARTYN, home from Ghana, is now with West and South African Mines' Services, Ltd., in London.

D. MORRIS is home from Ceylon.

W. L. G. MUIR is home from Sierra Leone.

L. B. PFEIL has been appointed managing director (research and technical) of the Mond Nickel Co., Ltd.

C. STENT has retired from the position of consulting metallurgist to Anglo American Corporation of South Africa, Ltd., after 16 years' service in that capacity and about 36 years with the Anglo American group.

D. V. G. TREGASKIS is home from Malaya.

P. VISWANATHAN informs us that while he has retired from service with Travancore Minerals he is not with the Department of Atomic Energy, as was stated in the May issue.

J. B. WALL is now in Tanganyika.

A. P. WARWICK is now in Ghana.

G. A. WHITWORTH, having reached retiring age, is to relinquish his appointment as Principal of the Camborne School of Metalliferous Mining on December 31 next. Lieut.-Col. Whitworth, formerly vice-principal, became acting principal in 1942, following the death of Mr. H. STANDISH BALL.

Correction.—We regret that in the June issue it was stated that Mr. A. A. VON MALTITZ had been appointed managing director of Anglo-Transvaal Consolidated Investment in succession to Mr. B. L. BERNSTEIN, which was incorrect. Mr. von Maltitz is technical director of the company, of which Mr. Bernstein is still managing director.

ARNOLD FRANK RADCLIFFE died on July 9, aged 63. A student at the Royal School of Mines in 1913 Mr. Radcliffe's training was interrupted by the 1914–1918 war during which he served with the Royal Engineers. Graduating in 1921 he worked first in France and then in both West and East Africa. From 1935 to 1938 he was assistant general superintendent of the Raibl mine, in northern Italy. During World War II Mr. Radcliffe again served with the army, on demobilization in 1946 becoming editor of *Mine and Quarry Engineering*. In 1950 he joined the staff of Rhodesian Selection Trust in London and on retirement two years later worked on engineering design. Mr. Radcliffe was an Associate Member of the Institution of Mining and Metallurgy.

HENRY HUGH WHITLOCK BOYES, who died on July 20, aged 71, was trained as a mining engineer in Scotland and at first worked in collieries. In 1913, however, he was in Nigeria but left the following year to join the Forces on the outbreak of war. He served with the R.E. Tunnelling Companies and gained the M.C. In 1919 after demobilization Major Boyes returned to Nigeria, managing various properties until 1927 when he joined the firm of Foley and Boyes, which later became Foley, Boyes, Bulter, and Peek, mining and consulting engineers. Until 1946 he remained in a managerial capacity, but in that year became a director of Amalgamated Tin Mines of Nigeria. A Member of the Institution of Mining and Metallurgy, of which he was a Vice-President, Major Boyes had also earned the Efficiency Decoration.

Metal Markets

During July [1]

Copper.—The somewhat unsettled state of the market during the first part of the year continued throughout July, despite the fact that United States copper mines were still at work, notwithstanding their original threat to strike on June 30. Following June's price falls the market had a steadier tone in the first week of the month.[2] However, the following week saw a cut in the U.S. custom smelters' price to 29½ cents and a weakness on the Commodity Exchange in New York, *plus* news of a record May output from Rhodesia and a big rise in Chilean production. Not surprisingly, quotations on the London market dipped sharply, beginning with a drop of £5 a ton on July 7, but they rallied—as did the New York prices—when Phelps Dodge in the U.S.A. announced a production cut of 7% on their January–June output. Rhodesian Selection Trust also announced that a cut—this time by 10% of their January–June output—in mid-July.

The strike which broke out in the American steel industry brought renewed fears of a stoppage among U.S. copper mines at the end of July or in early August. The possibility of a forthcoming temporary cessation of American output thus presented itself; this, *plus* the announcement of reduced world stocks because of heavy deliveries in June, also helped to revive market sentiment. Prospects remain uncertain, however, and it seems that what is needed is a series of production cutbacks by producers other than Phelps Dodge and R.S.T. if the present fundamental over-supply position is to be corrected and prices are not to be depressed further.

[1] Recent prices, pp. 44, 72.
[2] See Table, p. 72.

Copper consumption in the U.K. during May was 47,620 tons; production of refined copper was 6,869 tons of primary and 6,148 tons of secondary. Stocks rose to 66,498 tons and blister copper copper stocks closed at 12,007 tons.

Tin.—Tin prices [1] held up well in July, the Buffer Stock control system tending largely to insulate the market against outside influences such as the U.S. steel strike and the approaching holiday. Consumer demand was at a fairly high level throughout the month, but for a certain loss of interest on the part of the U.S. tinplate industry caused by the steel strike.

U.K. May consumption dropped slightly to 1,686 tons compared with 1,745 tons in April; production amounted to 1,808 tons. Stocks showed a further decline at 9,445 tons.

Lead.—Early in the month day to day lead prices [1] moved within reasonably tight limits and observers held out little hope for any appreciable improvement, at least until after the holiday season. Then, following substantial buying from an influential quarter and a certain falling off in supplies of Spanish lead, prices rose £4 a ton between July 10 and 20. As buying ceased at the beginning of the fourth week of the month, however, lead prices tended to recede again and the month drew to a close on a note of uncertainty.

U.K. lead consumption in May amounted to 27,280 tons. Stocks on May 31 totalled 63,135 tons, of which 53,056 tons were imported and the remaining 10,079 tons were English refined lead.

Zinc.—Zinc steadied itself early in the month at about £80 a ton, which a number of producers outside the U.S.A. tended to regard as a reasonably satisfactory price.[1] Consumption held up well as the month wore out, though July is generally the quietest period of the year and the price remained broadly steady but with a firm undertone.

U.K. zinc production stood at 5,938 tons in May, as compared with 5,424 tons in April. Consumption amounted to 26,167 tons.

Aluminium.—United States aluminium producers were reported in July to be in favour of raising prices in the near future to broaden the present narrow margin between production costs and sales revenue, especially in view of the currently troubled labour situation, but it seems that higher prices will be difficult to maintain for long unless Canadian producers take similar action. At present Canadian productive capacity is not being fully utilized, however, and it is unlikely that producers there will be keen to put up their prices until it is. Canadian aluminium is still quoted in the United Kingdom at £180 a ton.

Iron and Steel.—In June U.K. steel production rose to the highest level since April, 1958, although there remained plenty of capacity still unused. The holidays have now come to obscure the picture, but there is little doubt that broadly the steel industry has recovered from the recession. Home demand for the lighter products has improved and exports have generally picked up. It is in the heavy products such as plates and sections that interest has been weakest, but there has been some marginal improvement here and there is a good chance that after the holidays demand will increase. In fact the final quarter of the year is expected to be quite a good one for the steel industry as a whole.

Iron Ore.—U.K. imports of iron ore in June

[1] See Table, p. 72.

totalled 1,087,859 tons (1,364,375 tons in June, 1958), making 5,481,230 tons for the first half year (7,054,113 tons in January–June, 1958).

Antimony.—The market price of antimony remained unchanged during July; English regulus still fetches £197 10s. a ton. American producers have been complaining of imports from China *via* Russia and Belgium, but it is unlikely that any official action will be taken, at least for the present.

Arsenic.—There has been little to report on arsenic for some time now and July was no exception; the metal is still priced at £400 a ton.

Bismuth.—Trading in bismuth, for which the current quotation is 16s. a lb., was again quiet in July and there seems little likelihood of it picking up in the foreseeable future.

Cobalt.—Cobalt is another metal in which trading has been quiet; it is again quoted at 14s. a lb.

Cadmium.—Figures released last month show that while cadmium consumption in May was down 13 tons on the April figure, consumption for the first five months was up on that for the corresponding period of 1958 by more than 71 tons. The metal is now priced at 9s. per lb.

Chromium.—Chromium is priced once again at between 6s. 11d. and 7s. 4d. a lb.

Tantalum.—There have been intermittent inquiries during the month and the price has improved to 650s. to 700s. a unit. Union Carbide Metals in the U.S.A. reduced its tantalum price early in the month by $25 a lb.; the price is now $35 a lb.

Platinum.—U.K. and Empire platinum is still quoted at £28 10s. per troy oz. Imported metal fetches £26 10s. to £27 10s.

Iridium.—Iridium is quoted at £24 to £26 15s. an oz.

Palladium.—Palladium is still quoted at £7 5s. per troy oz.

Osmium.—The price of osmium is unchanged at £23 to £32 5s. per troy oz. The U.S. Government is reported to be planning to sell $3,000,000 worth of surplus minerals including osmium, which may result in its price being depressed in coming months.

Tellurium.—The American Smelting and Refining Co. has increased its tellurium price by 50 cents a lb. to $2·50. This is the second increase in recent months on anticipation of a growth in future demand. In the U.K. the price remains 14s. to 16s. per lb.

Tungsten.—Despite a certain amount of U.S. buying, the price of tungsten ore has declined further since last month's report. It now stands at 94s. 6d. to 99s. 6d.

Nickel.—The position is still one of over-supply and the price remains at £600 a ton.

Chrome Ore.—There has been little dealing in chrome ore in recent weeks. Current prices for Rhodesian and Turkish metallurgical 48% are £15 15s. c.i.f. and $33·50 f.o.b. a ton respectively.

Molybdenum.—Molybdenite is still quoted at 8s. 11d. per lb. of Mo, f.o.b.

Manganese Ore.—Indian producers have expressed dissatisfaction of the State Trading Corporation's unlimited quota policy and its influence on exports. The U.S. General Services Administration has decided, amid protests, to buy no more domestically produced manganese for stockpiling after August 5. The c.i.f. price is again nominally 70d. per unit for 46% to 48% material.

Tin, Copper, Lead, and Zinc Markets

Tin, minimum, 99·75%; Copper, electro; Lead, minimum 99·75%; and Zinc, minimum 98%, per ton.

Date	Tin		Copper		Lead		Zinc	
	Settlement	3 Months	Spot	3 Months	Spot	3 Months	Spot	3 Months
	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.
July 10	792 0	791 5	209 7½	210 12½	68 17½	70 3¾	79 15	78 18¾
13	792 0	789 5	210 7½	211 7½	69 13¾	70 15	80 2½	79 7½
14	793 0	798 5	216 2½	217 10	70 2½	70 13¾	79 16¼	79 2½
15	793 0	789 15	219 12½	221 5	70 1¼	70 13¾	79 15	79 3¾
16	793 0	790 5	226 15	227 15	70 7½	70 16¼	79 17½	79 5
17	793 10	790 10	224 2½	225 12½	70 12½	71 1¼	79 16¼	79 2½
20	794 0	790 5	222 2½	223 7½	71 11¼	71 17½	79 8¾	78 16¼
21	794 0	790 5	221 7½	223 2½	71 16¼	72 1¼	79 12½	78 18¾
22	793 0	790 5	221 17½	223 12½	72 16¼	72 16¼	79 17½	79 8¾
23	793 0	790 5	224 2½	225 7½	71 11¼	71 13¾	80 8¾	79 15
24	793 0	789 5	224 7½	224 17½	70 18¾	71 3¾	80 17½	80 3¾
27	793 10	789 5	226 2½	225 17½	71 7½	71 13¾	81 18¼	81 8¼
28	793 10	790 10	227 15	227 12½	71 6¼	71 13¾	82 8¾	81 13¾
29	793 0	790 10	226 5	226 17½	70 3¾	71 1¼	81 18¾	81 1¼
30	793 0	789 10	224 17½	224 12½	69 18¾	70 18¾	82 2½	81 2½
31	793 10	790 15	225 7½	225 2½	69 17½	71 0	82 13¾	81 10
Aug. 3	—	—	—	—	—	—	—	—
4	794 0	790 15	226 2½	225 17½	70 7½	71 2½	82 11¼	81 12½
5	793 0	790 5	225 12½	225 2½	70 17½	71 13¾	83 7½	82 2½
6	793 0	790 15	227 0	226 7½	71 13¾	72 2½	83 17½	82 8¾
7	793 0	790 5	228 5	227 7½	71 11¼	72 3¾	84 5	82 18¼
10	793 10	790 15	235 5	233 7½	71 16¼	72 11¼	84 6¼	83 2½

Statistics

TRANSVAAL AND O.F.S. GOLD OUTPUTS

	June		July	
	Treated Tons	Yield Oz.*	Treated Tons	Yield Oz.†
Blyvooruitzicht	132,000	84,421	135,000	85,735
Brakpan	138,000	16,925	143,000	17,255
Buffelsfontein‡	142,000	53,521	144,000	54,521
City Deep	117,000	24,339	121,000	24,931
Cons. Main Reef	117,000	19,621	110,000	19,997
Crown Mines	219,000	35,789	224,000	36,291
Daggafontein	244,000	48,806	244,000	48,525
Doornfontein‡	90,000	37,130	94,000	38,102
D'rb'n Roodeport Deep	192,000	35,748	200,000	37,207
East Champ D'Or‡	12,000	322	12,000	306
East Daggafontein	103,500	17,246	102,500	17,190
East Geduld	142,000	42,246	147,000	43,370
East Rand P.M.	223,000	57,080	234,000	60,447
Eastern Transvaal Consol	18,800	6,122	19,300	5,933
Ellaton‡	32,000	7,400	32,000	7,377
Freddies Consol.	64,000	14,376	63,000	14,445
Free State Geduld	86,000	68,155	88,000	71,061
Geduld	75,000	14,371	78,000	14,936
Government G.M. Areas‡	52,000	10,723	55,000	10,875
Grootvlei Proprietary	215,000	45,485	225,000	47,595
Harmony Gold Mining	141,000	55,135	147,000	58,076
Hartebeestfontein‡	88,000	47,980	88,000	47,520
Libanon	106,000	24,897	107,000	25,115
Loraine	80,000	15,600	82,000	15,990
Luipaards Vlei‡	125,000	14,342	125,000	14,378
Marievale Consolidated	98,000	23,707	101,000	24,349
Merriespruit‡	—	—	—	—
Modderfontein East	141,000	13,576	150,000	13,865
New Kleinfontein	84,000	10,498	83,000	10,924
New Klerksdorp‡	10,700	1,072	10,500	1,266
President Brand	112,500	91,125	118,000	95,876
President Steyn	107,000	41,096	106,000	40,584
Rand Leases	195,000	28,470	198,000	29,007
Randfontein‡	205,000	15,331	218,000	16,265
Rietfontein Consold't'd.	16,000	4,190	16,000	4,263
Robinson Deep	56,000	11,872	52,000	11,292
Rose Deep	44,000	5,228	44,000	5,339
St. Helena Gold Mines	155,000	47,278	160,000	49,203
Simmer and Jack	85,000	15,659	88,000	16,948
S. African Land and Ex.	101,000	20,972	102,000	21,163
S. Roodepoort M.R.	30,000	7,240	31,000	7,295
Spaarwater Gold	11,000	3,421	11,000	3,421
Springs	105,000	14,333	105,000	14,354
Stilfontein Gold Mining‡	145,000	68,991	145,000	68,577
Sub Nigel	66,500	15,910	66,500	15,835
Transvaal G.M. Estates	7,000	1,879	—	—
Vaal Reefs‡	92,900	41,400	94,000	42,300
Van Dyk Consolidated	75,000	14,116	76,000	14,571
Venterspost Gold	130,000	31,925	131,000	32,337
Village Main Reef	27,200	4,573	27,500	4,626
Virginia O.F.S.‡	134,000	31,362	134,000	31,155
Vlakfontein	50,500	18,157	51,000	18,253
Vogelstruisbult‡	90,000	20,237	93,000	20,592
Welkom Gold Mining	102,000	31,172	101,000	31,285
West Driefontein‡	96,000	87,638	97,000	88,542
West Rand Consol.‡	217,000	22,510	223,000	22,950
Western Holdings	132,000	80,579	136,000	82,961
Western Reefs	139,000	36,766	139,000	36,767
Winkelhaak	78,000	20,085	81,000	20,983
Witwatersrand Nigel	18,200	4,379	18,200	4,385

† 249s. 1d. * 249s. 2d. ‡ Gold and Uranium.

COST AND PROFIT IN THE UNION

	Tons milled	Yield per ton	Work'g cost per ton	Work'g profit per ton	Total working profit
		s. d.	s. d.	s. d.	£
Mar., 1958	15,806,300	64 10	46 6	18 4	23,170,987
April	—	—	—	—	—
May	—	—	—	—	—
June*	16,435,500	64 9	46 6	18 3	24,358,945
July	—	—	—	—	—
August	—	—	—	—	—
Sept.*	16,760,400	65 10	46 9	19 1	25,633,898
Oct.	—	—	—	—	—
Nov.	—	—	—	—	—
Dec.	16,540,150	67 7	47 10	19 9	25,934,441
Jan., 1959	—	—	—	—	—
Feb.	—	—	—	—	—
Mar.	16,743,500	68 0	45 4	22 8	25,934,881

* 3 Months.

PRODUCTION OF GOLD IN SOUTH AFRICA

	Rand and O.F.S.	Outside	Total
	Oz.	Oz.	Oz.
July, 1958	1,456,925	42,312	1,499,237
August	1,463,259	36,413	1,499,672
September	1,465,697	36,799	1,502,496
October	1,516,701	44,025	1,560,726
November	1,484,844	32,349	1,517,193
December	1,480,525	40,372	1,520,895
January, 1959	1,506,670	39,515	1,546,187
February	1,472,090	34,618	1,506,708
March	1,561,196	32,271	1,593,467
April	1,616,891	36,815	1,653,706
May	1,641,990	30,371	1,672,361
June	1,665,503	34,465	1,699,968

NATIVES EMPLOYED IN THE SOUTH AFRICAN MINES

	Gold Mines	Coal Mines	Total
October 31, 1958	335,003	32,657	367,660
November 30	332,443	32,851	365,294
December 31	329,234	32,946	362,180
January 31, 1959	350,656	—	—
February 28	396,217	33,859	430,076
March 31	379,257	32,982	412,239
April 30	383,710	33,081	416,791
May 31	385,278	33,186	418,464
June 30	383,903	33,146	417,049

MISCELLANEOUS METAL OUTPUTS

	4-Week Period To July 25		
	Tons Ore	Lead Concs. tons	Zinc Concs. tons
Broken Hill South	25,850	4,213	4,824
Electrolytic Zinc	17,702	1,015	5,289
Lake George	13,395	947	1,861
Mount Isa Mines**	55,176	3,450†	1,865
New Broken Hill	57,190	8,191	12,051
North Broken Hill	35,596	6,844	7,418
Zinc Corp.	59,560	7,439	9,416
Rhodesia Broken Hill*	—	—	—

* 3 Mths. ** Copper 2,355 tons. † Metal.

RHODESIAN GOLD OUTPUTS

	June		July	
	Tons	Oz.	Tons	Oz.
Cam and Motor	31,625	—	32,073	—
Falcon Mines	20,000	3,721	20,450	3,855
Globe and Phœnix	—	—	6,200	3,164
Motapa Gold Mining	14,350	1,351	—	—
Mazoe	3,105	—	3,103	—
Coronation Syndicate	11,916	—	12,006	—
Phœnix Prince*	40,430	3,589	—	—

* 3 Months.

WEST AFRICAN GOLD OUTPUTS

	June		July	
	Tons	Oz.	Tons	Oz.
Amalgamated Banket	64,948	15,444	—	—
Ariston Gold Mines	36,120	13,085	38,170	13,072
Ashanti Goldfields	34,000	27,000	32,500	27,000
Bibiani	33,500	7,200	33,500	7,200
Bremang	—	3,607	—	5,531
Ghana Main Reef	11,262	4,368	11,927	4,106
Konongo	6,700	3,860	6,600	3,835
Lyndhurst	—	—	—	—

RODUCTION OF GOLD AND SILVER IN RHODESIA

	1958		1959	
	Gold (oz.)	Silver (oz.)	Gold (oz.)	Silver (oz.)
January	44,305	46,553	46,489	18,077
February	43,591	21,313	43,366	19,806
March	43,830	8,179	—	—
April	46,587	22,573	—	—
May	46,015	19,937	—	—
June	46,453	20,105	—	—
July	44,244	19,170	—	—
August	47,484	20,549	—	—
September	48,295	21,141	—	—
October	46,311	6,342	—	—
November	47,994	16,435	—	—
December	48,888	30,724	—	—

WESTRALIAN GOLD PRODUCTION

	1957	1958	1959
	Oz.	Oz.	Oz.
January	106,722	66,562	63,924
February	64,949	65,965	65,035
March	67,121	65,420	65,408
April	66,435	60,855	62,686
May	64,886	64,196	64,184
June	65,142	67,929	74,590
July	74,420	81,106	—
August	75,727	68,610	—
September	64,422	68,744	—
October	64,524	70,128	—
November	65,700	67,562	—
December	66,562	120,106	—
Total	846,610	867,187	—

AUSTRALIAN GOLD OUTPUTS

	4-Week Period			
	To June 23		To July 21	
	Tons	Oz.	Tons	Oz.
Central Norseman	14,124	7,567	13,846	7,591
Croesus Proprietary	—	—	—	—
Gold Mines of Kalgoorlie	40,965	11,225	39,642	11,755
Golden Horse Shoe*	—	—	—	—
Gt. Boulder Gold Mines*	—	—	—	—
Gt. Western Consolidated	33,276	6,203	32,683	5,579
Hill 50*	—	—	—	—
Kalgurli Ore Treatment	—	—	—	—
Lake View and Star*	215,420	49,143	—	—
Moonlight Wiluna*	8,229	3,661	—	—
Morning Star (G.M.A.)	2,421	686	1,633	398
Mount Ida*	—	—	—	—
New Coolgardie	—	—	—	—
North Kalgurli	27,630	6,902	—	—
Sons of Gwalia	12,718	2,304	—	—
Mount Morgan	—	5,761	—	4,886

*3 Months

ONTARIO GOLD AND SILVER OUTPUT

	Tons Milled	Gold Oz.	Silver Oz.	Value Canad'n $
February, 1958	727,170	219,502	31,562	7,462,598
March	807,458	210,646	35,370	7,248,333
April	785,264	229,361	38,323	7,873,264
May	801,102	228,590	35,712	7,789,644
June	775,384	228,123	37,535	7,745,425
July	750,410	228,960	42,275	7,740,144
August	740,459	218,126	38,940	7,355,406
September	771,115	202,798	31,543	7,006,517
October	801,965	209,006	34,914	7,178,218
November	783,065	230,251	35,097	7,842,435
December	787,573	219,351	30,989	7,490,094
January, 1959	799,178	227,656	41,277	7,700,672
February	727,843	227,981	32,976	7,798,523
March	807,952	223,728	33,045	7,616,425
April	776,583	225,027	32,778	7,712,425
May	791,199	227,924	34,006	7,713,970

MISCELLANEOUS GOLD AND SILVER OUTPUTS

	June		July	
	Tons	Oz.	Tons	Oz.
British Guiana Cons.	—	—	—	—
Central Victoria Dredging	—	—	—	—
Clutha River	—	1,335	—	757
Emperor Mines (Fiji)*	—	—	—	—
Frontino Gold (Colombia)	—	—	—	—
Geita Gold (Tanganyika)	—	—	—	—
Harrietville (Aust.)	—	—	—	—
Lampa (Peru)†	—	39,498	—	—
Loloma (Fiji)*	—	—	—	—
New Guinea Goldfields	3,684	1,392	—	—
St. John d'el Rey (Brazil)	—	—	—	—
Yukon Consol.	—	$301,000	—	—

* 3 Months. † Oz. Silver: Copper, 98 tons.

OUTPUTS OF MALAYAN TIN COMPANIES IN LONG TONS OF CONCENTRATES

	May	June	July
Ampat Tin	46	46	38
Austral Amalgamated	—	—	—
Ayer Hitam	—	170	—
Batu Selangor	—	—	—
Berjuntai	119	126	127
Chenderiang	—	—	—
Gopeng Consolidated	—	121*	—
Hongkong Tin	—	49½*	—
Idris Hydraulic	—	29*	—
Ipoh	—	51*	—
Jelapang Tin	—	—	—
Kampong Lanjut	44½	68	83
Kamunting	113½	92	100
Kent (F.M.S.)	—	38*	—
Kepong	—	—	—
Killinghall	—	54*	—
Kinta Kellas	—	—	—
Kinta Tin Mines	—	63½	—
Klang River	—	—	—
Kramat	—	—	7
Kuala Kampar	140	90	80
Kuala Lumpur	—	—	—
Kuchai	—	—	—
Lahat Mines	—	—	—
Larut	—	—	—
Lower Perak	42½	51	69
Malayan	—	290*	—
Malaysiam	—	—	6
Pacific Tin Consolidated	—	—	—
Pahang Consolidated	—	372*	—
Pengkalen	—	62*	—
Petaling Tin	—	204½*	—
Puket	—	—	—
Rahman Hydraulic	—	—	—
Rambutan	—	30*	—
Rantau	15½	23½	39½
Rawang Concessions	—	—	—
Rawang Tin Fields	—	—	—
Renong	—	124*	—
Selayang	—	41*	—
Siamese Tin Syndicate (Malaya)	17	16	—
Southern Kinta	323	178	135
Southern Malayan	—	492*	—
Southern Tronoh	—	—	—
Sungei Besi	—	157*	—
Sungei Kinta	—	38*	—
Sungei Way	—	201*	—
Taiping Consolidated	37	20	18
Tambah	—	—	—
Tanjong	—	131*	—
Tekka	—	26*	—
Tekka-Taiping	—	—	—
Temoh	—	13*	—
Tongkah Compound	—	—	—
Tongkah Harbour	32	28	22
Tronoh	—	564*	—
Ulu Klang	—	—	—

* 3 Months.

MISCELLANEOUS TIN COMPANIES' OUTPUTS IN LONG TONS OF CONCENTRATES

	June		July	
	Tin	Columbite	Tin	Columbite
Amalgamated Tin Mines ..	186	27	254	—
Anglo-Burma Tin *.....	18	—	—	—
Bangrin.....	22	—	29	—
Beralt	35	132†	32	160†
Bisichi.....	31	29½	35	26
Ex-Lands Nigeria	32	—	38	—
Geevor.....	60	—	58	—
Gold and Base Metal	40	4	—	—
Jantar Nigeria	10½	30	—	—
Jos Tin	9	—	—	—
Kaduna Prospectors	3	—	4	—
Kaduna Syndicate.....	12½	—	13	—
Katu Tin.....	22	—	12	—
Keffi Tin	—	—	—	—
London Nigerian Mines ...	—	—	—	—
Mawchi Mines	—	—	—	—
Naraguta Extended	5½	—	—	—
Naraguta Karama.....	4	—	—	—
Naraguta Tin.....	—	—	—	—
Renong Consolidated	—	—	—	—
Ribon Valley (Nigeria)....	10	1½	—	—
Siamese Tin Syndicate	14	—	9	—
South Bukeru.....	—	—	—	—
South Crofty	80	—	82	—
Tavoy Tin.....	—	—	—	—
Tin Fields of Nigeria.....	—	—	—	—
United Tin Areas of Nigeria	—	—	—	—

* 3 months. † Wolfram.

SOUTH AFRICAN MINERAL OUTPUT

May, 1959

Gold.....	1,664,802 oz.
Silver.....	166,067 oz.
Diamonds	203,576 carats.*
Coal	3,352,044 tons.
Copper.....	(*a*) — tons in matte and copper-gold concentrates. (*b*) 4,710 tons of 99·28%.
Tin.....	197 tons concs.
Platinum (concentrates, etc.)	—
Platinum (crude)	—
Asbestos.....	15,461 tons.
Chrome Ore	60,323 tons.
Manganese Ore	88,280 tons.
Lead Concs.....	— tons.

* Apr., 1959.

IMPORTS OF ORES, METALS, ETC., INTO UNITED KINGDOM

		April	May
Iron Ore	tons	754,344	863,431
Manganese Ore.....	„	41,776	25,780
Iron and Steel	„	58,490	57,455
Iron Pyrites	„	13,784	9,090
Copper Metal	„	36,627	37,171
Tin Ore	„	3,417	3,940
Tin Metal	„	—	28
Lead	„	23,538	14,364
Zinc Ore and Conc.	„	4,583	4,519
Zinc	„	14,985	12,763
Tungsten Ores	„	305	379
Chrome Ore	„	12,539	7,658
Bauxite	„	26,146	14,576
Antimony Ore and Concs.....	„	—	1,000
Titanium Ore	„	42,807	28,605
Nickel Ore	„	—	—
Tantalite/Columbite	„	14	74
Sulphur	„	25,669	30,142
Barytes	„	2,663	2,913
Asbestos	„	8,779	11,264
Magnesite	„	1,318	1,749
Mica	„	332	435
Graphite	„	437	448
Mineral Phosphates	„	127,003	103,640
Molybdenum Ore	„	279	538
Nickel	cwt.	80,759	43,404
Aluminium	„	399,005	303,517
Mercury.....	lb.	113,995	93,210
Bismuth	„	88,049	136,947
Cadmium	„	194,508	176,148
Cobalt and Cobalt Alloys	„	11,540	210,702
Selenium	„	27,867	12,525
Petroleum Motor Spirit	1,000 gals.	80,457	76,671
Crude	„	968,388	980,827

Prices of Chemicals

The figures given below represent the latest available.

		£	s.	d.
Acetic Acid, Glacial	per ton	106	0	0
„ „ 80% Technical	„	97	0	0
Alum, Comml.	„	25	0	0
Aluminium Sulphate.....	„	16	10	0
Ammonia, Anhydrous	per lb.		2	0
Ammonium Carbonate	per ton	59	0	0
„ Chloride, 98%	„	26	0	0
„ Phosphate (Mono- and Di-) ...	„	102	0	0
Antimony Sulphide, golden	per lb.		3	0
Arsenic, White, 99/100%	per ton	47	10	0
Barium Carbonate (native), 94%	„	Nominal		
„ Chloride	„	53	0	0
Barytes (Bleached)	„	20	0	0
Benzene	per gal.		5	2
Bleaching Powder, 36% Cl.	per ton	30	7	6
Borax	„	45	0	0
Boric Acid, Comml.	„	75	10	0
Calcium Carbide	„	40	17	9
„ Chloride, solid, 70/75%	„	13	5	0
Carbolic Acid, crystals	per lb.		1	6
Carbon Bisulphide.....	per ton	62	10	0
Chromic Acid (ton lots)	per lb.		2	2¼
Citric Acid	per cwt.	11	0	0
Copper Sulphate	per ton	76	0	0
Creosote Oil (f.o.r. in Bulk)	per gal.		1	2
Cresylic Acid, refined	„		6	10
Hydrochloric Acid 28° Tw.....	per carboy		13	0
Hydrofluoric Acid, 59/60%	per lb.		1	1
Iron Sulphate.....	per ton	3	17	6
Lead, Acetate, white	„	124	0	0
„ Nitrate	„	116	0	0
„ Oxide, Litharge	„	107	5	0
„ Red.....	„	105	5	0
„ White	„	117	0	0
Lime Acetate, brown	„	40	0	0
Magnesite, Calcined	„	20	0	0
„ Raw	„	9	0	0
Magnesium Chloride, ex Wharf	„	16	0	0
„ Sulphate, Comml.	„	15	10	0
Methylated Spirit, Industrial, 66 O.P.....	per gal.		6	3
Nitric Acid, 80° Tw.	per ton	37	10	0
Oxalic Acid	„	129	0	0
Phosphoric Acid (S.G. 1·750)	per lb.		1	4
Pine Oil.....	per ton	Nominal		
Potassium Bichromate	per lb.		1	2¼
„ Carbonate (hydrated)	per ton	74	10	0
„ Chloride	„	21	0	0
„ Iodide	per lb.		7	3
„ Amyl Xanthate	„	Nominal		
„ Ethyl Xanthate	„	Nominal		
„ Hydrate (Caustic) flake	per ton	118	0	0
„ Nitrate	per cwt.	4	1	0
„ Permanganate	per ton	193	10	0
„ Sulphate, 50%	„	21	1	0
Sodium Acetate	„	75	10	0
„ Arsenate, 58–60%.....	„	Nominal		
„ Bicarbonate	„	15	0	0
„ Bichromate	per lb.		1	0
„ Carbonate (crystals)	per ton	Nominal		
„ „ (Soda Ash) 58%	„	13	15	0
„ Chlorate	„	91	0	0
„ Cyanide 100% NaCN basis	per cwt.	6	6	6
„ Hydrate, 76/77%, solid	per ton	33	0	0
„ Hyposulphite, Comml.	„	32	15	0
„ Nitrate, Comml.	„	29	0	0
„ Phosphate (Dibasic)	„	40	10	0
„ Prussiate	per lb.		1	0½
„ Silicate	per ton	11	0	0
„ Sulphate (Glauber's Salt)	„	9	15	0
„ „ (Salt-Cake)	„	10	0	0
„ Sulphide, flakes, 60/62%.....	„	38	12	6
„ Sulphite, Comml.	„	27	10	0
Sulphur, American, Rock (Truckload).....	„	14	0	0
„ Ground, Crude	„	17	10	0
Sulphuric Acid, 168° Tw.	„	12	0	0
„ „ free from Arsenic, 140° Tw.	„	7	0	0
Superphosphate of Lime, 18% P_2O_5	„	14	18	6
Tin Oxide	„	Nominal		
Titanium Oxide, Rutile	„	172	0	0
„ White, 25%	„	85	0	0
Zinc Chloride	„	95	0	0
„ Dust, 95/97% (4-ton lots)	„	109	0	0
„ Oxide	„	95	0	0
„ Sulphate.....	„	32	0	0

Share Quotations

Shares of £1 par value except where otherwise stated.

GOLD AND SILVER:	July 1, 1959 £ s. d.	Aug. 4, 1959 £ s. d.
SOUTH AFRICA:		
Blinkpoort (5s.)	4 15 0	4 18 9
Blyvooruitzicht (2s. 6d.)	1 7 0	1 6 6
Brakpan (5s.)	5 0	5 0
Buffelsfontein (10s.)	2 14 0	2 11 3
City Deep	1 2 9	1 3 6
Consolidated Main Reef	19 6	1 0 6
Crown Mines (10s.)	1 6 6	1 8 3
Daggafontein (5s.)	1 9 6	1 7 9
Dominion Reefs (5s.)	14 9	13 9
Doornfontein (10s.)	1 13 9	1 11 0
Durban Roodepoort Deep (10s.)	1 15 0	1 14 3
East Champ d'Or (2s. 6d.)	2 3	2 0
East Daggafontein (10s.)	9 0	9 6
East Geduld (4s.)	1 4 3	1 3 0
East Rand Ext. (5s.)	1 12 9	1 11 3
East Rand Proprietary (10s.)	2 4 0	2 3 3
Freddies Consol.	2 6	2 6
Free State Dev. (5s.)	11 6	11 6
Free State Geduld (5s.)	9 13 9	9 12 6
Free State Saaiplaas (10s.)	1 1 9	1 3 0
Geduld	3 5 0	3 1 9
Government Gold Mining Areas (3d.)	3 6	3 6
Grootvlei (5s.)	19 6	1 0 0
Harmony (5s.)	2 3 6	2 2 9
Hartebeestfontein (10s.)	3 4 6	2 19 3
Libanon (10s.)	11 0	12 6
Loraine (10s.)	1 13 3	1 15 9
Luipaards Vlei (2s.)	9 3	8 6
Marievale (10s.)	1 7 9	1 7 6
Merriespruit (5s.)	5 0	5 0
Modderfontein B (3d.)	2 3	2 0
Modderfontein East	15 9	17 3
New Kleinfontein	5 9	5 6
New Pioneer (5s.)	2 2 3	1 18 3
New State Areas (15s. 6d.)	2 0	1 6
President Brand (5s.)	3 9 6	3 10 0
President Steyn (5s.)	1 11 3	1 12 6
Rand Leases (9s. 3d.)	6 9	7 0
Randfontein	1 4 0	1 2 3
Rietfontein (3s. 2d.)	5 0	5 0
Robinson Deep (5s. 6d.)	7 3	7 0
Rose Deep (3s. 6d.)	10 9	10 9
St. Helena (10s.)	3 9 0	4 6 6
Simmer and Jack (1s. 6d.)	2 3	2 0
South African Land (3s. 6d.)	1 2 3	1 1 0
Springs (5s.)	1 9	1 9
Stilfontein (5s.)	2 2 3	2 0 6
Sub Nigel (8s. 6d.)	12 9	12 9
Vaal Reefs (5s.)	2 4 3	2 1 0
Van Dyk (3d.)	3 9	4 0
Venterspost (10s.)	17 6	16 6
Virginia (5s.)	6 9	6 9
Vlakfontein (10s.)	1 0 0	19 3
Vogelstruisbult (10s.)	9 3	9 3
Welkom (5s.)	1 4 6	1 3 3
West Driefontein (10s.)	6 16 6	7 8 9
West Rand Consolidated (10s.)	1 5 3	1 2 3
West Witwatersrand Areas (2s. 6d.)	3 6 0	3 11 3
Western Holdings (5s.)	8 15 0	8 17 6
Western Reefs (5s.)	1 9 0	1 6 3
Winkelhaak (10s.)	1 4 6	1 7 3
Witwatersrand Nigel (2s. 6d.)	1 0	1 3
Zandpan (10s.)	19 9	19 9
RHODESIA:		
Cam and Motor (2s. 6d.)	8 3	9 0
Chicago-Gaika (10s.)	15 0	17 6
Coronation (2s. 6d.)	4 3	5 0
Falcon (5s.)	8 0	8 6
Globe and Phœnix (5s.)	1 11 9	1 11 0
Motapa (5s.)	9	6
GOLD COAST:		
Amalgamated Banket (3s.)	1 0	1 3
Ariston Gold (2s. 6d.)	4 0	4 0
Ashanti Goldfields (4s.)	16 9	18 0
Bibiani (4s.)	2 6	2 6
Bremang Gold Dredging (5s.)	2 3	2 3
Ghana Main Reef (5s.)	2 3	2 9
Konongo (2s.)	1 9	1 9
Kwahu (2s.)	4 0	4 0
Western Selection (5s.)	5 6	5 3
AUSTRALASIA:		
Gold Fields Aust. Dev. (3s.), W.A.	2 3	2 6
Gold Mines of Kalgoorlie (10s.)	9 6	9 6
Great Boulder Propriet'y (2s.), W.A.	12 9	12 9
Lake View and Star (4s.), W.A.	1 9 9	1 8 0
London-Australian (2s.)	7½	9
Mount Morgan (10s.), Q.	14 0	15 6
New Guinea Gold (4s. 3d.)	1 6	1 9
North Kalgurli (1912) (2s.), W.A.	10 6	10 9
Sons of Gwalia (10s.), W.A.	3 0	3 0
Western Mining (5s.), W.A.	10 9	10 6

	July 1, 1959 £ s. d.	Aug. 4, 1959 £ s. d.
MISCELLANEOUS:		
Fresnillo ($1·00)	1 11 0	1 11 0
Kentan Gold Areas	2 3 6	2 0 9
St. John d'el Rey, Brazil	4 0 0	3 12 6
Yukon Consolidated ($1)	7 0	5 9
COPPER:		
Bancroft Mines (5s.), N. Rhodesia	1 3 3	1 3 3
Esperanza (2s. 6d.), Cyprus	1 7½	1 6
Indian (2s.)	4 9	4 9
MTD (Mangula) (5s.)	9 3	9 3
Messina (5s.), Transvaal	5 8 3	5 11 3
Mount Lyell, Tasmania	1 5 3	1 7 0
Nchanga Consolidated, N. Rhodesia	12 6 3	12 2 9
Rhokana Corporation, N. Rhodesia	28 15 0	30 5 0
Roan Antelope (5s.), N. Rhodesia	8 0	7 6
Tanganyika Concessions (10s.)	2 9 0	2 7 0
LEAD-ZINC:		
Broken Hill South (1s.), N.S.W.	10 0	10 9
Burma Mines (3s. 6d.)	1 9	1 9
Consol. Zinc Corp. Ord.	3 3 3	3 6 9
Lake George (5s.), N.S.W.	3 3	3 6
Mount Isa, Queensland (5s. Aust.)	1 18 6	2 0 3
New Broken Hill (5s.), N.S.W.	1 13 3	1 13 9
North Broken Hill (5s.), N.S.W.	3 16 3	3 15 0
Rhodesia Broken Hill (5s.)	8 9	9 3
San Francisco (10s.), Mexico	19 3	19 3
TIN:		
Amalgamated Tin (5s.), Nigeria	7 6	7 3
Ampat (4s.), Malaya	8 6	8 9
Ayer Hitam (5s.), Malaya	1 17 0	1 16 3
Beralt (5s.), Portugal	1 7 0	1 7 0
Bisichi (2s. 6d.), Nigeria	3 9	3 9
Ex-Lands (2s.), Nigeria	2 0	2 0
Geevor (5s.), Cornwall	1 3 6	1 3 6
Gold Base Metals (2s. 6d.), Nigeria	1 0	1 0
Hongkong (5s.), Malaya	4 6	4 3
Jantar Nigeria (3s.)	3 9	3 6
Kaduna Syndicate (2s.), Nigeria	2 0	2 0
Kamunting (5s.), Malaya	11 3	11 9
Malayan Tin Dredging (5s.)	17 6	19 0
Mawchi Mines (4s.), Burma	2 6	2 0
Naraguta Extended (5s.), Nigeria	9	1 0
Pahang (5s.), Malaya	5 0	4 9
Siamese Synd. (5s.)	7 9	7 0
South Crofty (5s.), Cornwall	4 0	4 0
Southern Kinta (5s.), Malaya	1 2 3	1 2 9
Southern Malayan (5s.)	14 3	13 3
Southern Tronoh (5s.), Malaya	12 6	11 9
Sungei Besi (4s.), Malaya	7 6	7 9
Sungei Kinta, Malaya	14 0	13 0
Tekka (12s. 6d.), Malaya	3 9	4 6
Tronoh (5s.), Malaya	13 9	13 9
United Tin Areas (2s. 6d.), Nigeria	9	9
DIAMONDS:		
Anglo American Investment	14 0 0	14 11 3
Consol African Selection Trust (5s.)	1 0 0	1 1 0
Consolidated of S.W.A. Pref. (10s.)	11 0	11 0
De Beers Deferred (5s.)	8 1 9	8 13 0
FINANCE, Etc.		
African & European (10s.)	4 6 6	4 7 6
Anglo American Corporation (10s.)	9 9 0	9 13 9
Anglo-French Exploration	1 16 3	2 0 3
Anglo Transvaal 'A' (5s.)	2 7 0	2 5 0
British South Africa (15s.)	4 13 0	4 13 6
British Tin Investment (10s.)	1 1 0	1 1 6
Broken Hill Proprietary	2 6 0	2 9 6
Camp Bird (10s.)	11 0	11 0
Central Mining	3 19 6	3 18 6
Central Provinces Manganese (10s.)	1 10 9	1 9 3
Consolidated Gold Fields	3 10 6	4 1 6
Consolidated Mines Selection (10s.)	2 5 0	2 4 6
East Rand Consolidated (5s.)	2 0	1 9
Free State Development (5s.)	11 6	11 3
General Exploration O.F.S. (2s. 6d.)	5 6	6 6
General Mining and Finance	7 1 3	7 2 3
H.E. Proprietary (5s.)	15 6	1 6 0
Johannesburg Consolidated	3 6 0	3 3 3
London & Rhod. M. & L. (5s.)	7 9	8 6
London Tin Corporation (4s.)	8 9	8 6
Lydenburg Est. (5s.)	19 6	17 9
Marsman Investments (10s.)	1 7	1 7
National Mining	2 6	3 0
Rand Mines (5s.)	4 17 6	5 0 0
Rand Selection (5s.)	2 16 0	2 18 0
Rhodesian Anglo American (10s.)	4 5 0	4 4 0
Rhodesian Corporation (5s.)	3 3	3 3
Rhodesian Selection Trust (5s.)	15 0	15 0
Rio Tinto (10s.)	2 7 6	2 8 0
Selection Trust (10s.)	5 13 0	5 12 0
South West Africa Co. (3s. 4d.)	12 6	15 0
Union Corporation (2s. 6d.)	3 3 3	3 9 6
Vereeniging	6 8 3	6 12 9
West Rand Inv. Trust (10s.)	2 19 6	2 17 6

THE MINING DIGEST

A RECORD OF PROGRESS IN MINING, METALLURGY, AND GEOLOGY

In this section abstracts of important articles and papers appearing in technical journals and proceedings of societies are given, together with brief records of other articles and papers; also notices of new books and pamphlets and lists of patents on mining and metallurgical subjects.

Drilling for Geothermal Steam

An article in the *Chemial Engineering and Mining Review* of Melbourne for May 15 describes the drilling techniques employed in the development of New Zealand's geothermal steam power project at Wairakei. This is an active area in a zone of thermal activity extending from the volcanoes of the North Island north-eastwards for about 150 miles to White Island. In a basal formation of hard, dense impermeable ignimbrite of unknown thickness a number of nearly vertical fissures have been produced by faulting. Hot fluids are believed to ascend through these fissures, permeating the overlying formation of rhyolite and pumice breccia. Best results have been obtained by tapping this flow near the top of the ignimbrite at fault planes. Drilling has revealed no evidence of any cap rock formation under which large quantities of steam might accumulate as at Larderello. Explanation for the Wairakei steam output is that it is generated from hot water when the pressure is released by discharging through bores. There is no production from the basal ignimbrite, unless the bore intersects a fissure and this formation has not yet been pierced through, although one bore has penetrated it to a depth of 1,700 ft. Conditions below it are still unknown.

The wellhead product is a mixture of steam and hot water including various chemicals and gases, discharged within a wide range of wellhead gauge pressures and output figures. For operating purposes, however, there are two main categories; h.p. steam between 210 and 220 p.s.i., and l.p. between 75 and 85 p.s.i.

Drilling methods at Wairakei closely follow those used in oil production, modified to meet the special demands of the project. Light truck-mounted rotary drilling units were used for early exploration, but the bulk of the work is now being done by two T-12 American rigs with 95-ft. telescopic 80-ton capacity hinged masts and a nominal range of 1,500 ft. to 3,000 ft. These units are highly mobile, being mounted on semi-trailers, with some of the auxiliary equipment. All other associated equipment, including pumps, and tanks for drilling fluid, is also easily portable. So far about 60 bores have been drilled, some 40 of them suitable for production, varying in depth from 560 ft. to 4,000 ft. but with an average of about 2,000 ft. In most cases the production casing diameter is 8 in.

A rectangular concrete wellhead cellar is built at the bore site, 10 ft. by 8 ft. deep, with two emergency exits, one a stairway, for use should steam or gas escape in the cellar or scalding fluids fall from above. The surrounding country is consolidated by grouting with cement to a radius of 30 ft. and to depths varying from 100 ft. near the cellar to 50 ft. at the perimeter. Drilling begins through the bottom of the cellar and 16-in. surface casing is cemented to the hole walls usually to a depth of about 60 ft. Within this and to a depth of from 300 ft. to 400 ft., 11¾-in. anchor casing is cemented in place. Production casing of 8⅝ in. nominal o.d. goes within this again from the surface to 1,000 ft. to 2,000 ft. In all cases seamless steel casing complying with the American Petroleum Institute Specification is used.

Production in the past has been from the open hole below this casing, but 6-in. or 6⅝-in. o.d. slotted liners are now being used, either resting on the bottom of the hole or suspended from the production casing.

To control a bore while drilling at depth, wellhead equipment consists of a drilling-through valve (which enables the bore to be closed when no drilling tools are in place), double control gates, manually operated and a blowout preventer which is hydraulically operated by remote control. If dangerous pressures arise in the bore the blowout preventer can be closed almost instantly and the control gates afterwards. The double control gates consist of two independent horizontal gates each split diametrically and with each half-gate fitted with semi-circular rubber rams which will tightly grip the drill string or casing when the two halves are brought together. Straight rams to close the bore completely can also be fitted.

Perhaps the most important control measure, however, is the cooling action and pressure of the drilling mud. This fluid, similar to one of the many types used in oil-well drilling, is used to cool and lubricate the drilling bit, to remove cuttings from the hole and to assist in maintaining the stability of the hole walls. This mud is pumped down the interior of the drill pipe, returning to the surface up the bore laden with rock cuttings, which are removed on vibrating screens. Before being recirculated part of it is cooled in a cooling tower, where between 4 and 6 million B.Th.U. an hour are extracted. Usually mud returning from a bore is between 55° and 65° C., but occasionally temperatures near or at boiling point are reached. Prolonged cooling by circulation then becomes necessary.

Pumping rates during drilling are between 250 and 350 gallons a minute.

Cooling by circulation is also used prior to and during the operation of running casing. Frequently this continues for several hours after casing has reached the required depth, being maintained until the returning mud is between 35° and 45° C. This permits satisfactory cementing for casing strings up to 2,000 ft.

So far no case of loss of control permitting a bore to erupt has occurred in New Zealand and there has been a remarkably good accident record with no fatalities or major injury.

When casing is being placed a float collar fitted with an upward seating ballvalve is placed at the first join, about 30 ft. from the bottom. This permits the casing to float to a certain extent while being lowered and, while allowing the downward circulation of drilling fluid or cement, prevents fluids being forced up the casing should pressure develop.

Temperature changes are the cause of the most severe stressing suffered by the casing after completion of drilling. In a properly cemented bore these stresses are transmitted to the formation through the cement, but if cementing is inadequate casing failure can occur through collapse or tension. Accordingly Wairakei engineers attach great importance to proper completion of this work.

Cement slurry continuously mixed at a rate of 20 cu. ft. a minute in a jet mixer is pumped down the inside of the casing in sufficient quantity to provide a return at the surface, when the interior of the casing has been cleared of cement by pumping mud down on top of it—with two fluids separated by a plug. When there is no return owing to loss in porous formation or crevices, more slurry is pumped down the annulus until it is completely filled with cement and there is a refusal pressure of 50 p.s.i. or more.

At first a bore is allowed to discharge vertically until no debris is being ejected. In some cases large quantities of rock, grit, and fine material have been discharged, but a slotted liner materially reduces this. Next a horizontal bypass terminating in a silencer is brought into use and the bore is allowed to discharge continuously for as long as practicable.

In bores standing shut wellhead gauge pressure is usually between 50 and 90 p.s.i., but sometimes much higher, even 500 p.s.i., where gas accumulates. Pressures rise when a bore is closed after discharging, mostly to between 150 and 200 p.s.i., then gradually fall to the normal shut-in figure. While discharging bore wellhead pressures tend to fluctuate rapidly up to 50 p.s.i. for h.p. bores and to 25 p.s.i. for l.p., but generally within a range of about half these figures. Maximum temperatures usually do not exceed 250° C. They are generally not less than 230° C. in h.p. bores and no less than 200° C. in l.p. bores.

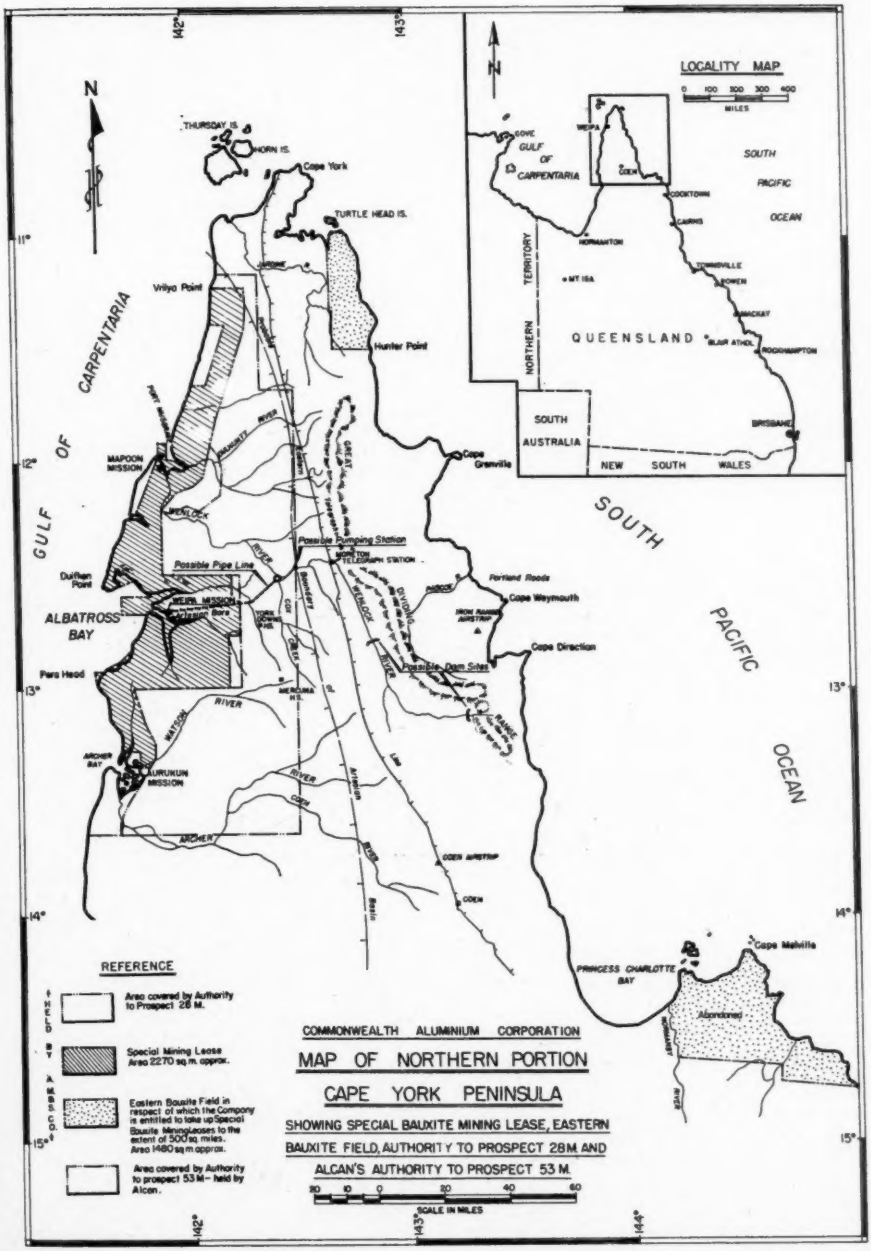
High-intensity noise created by bores without silencers was found to be both a nuisance and a possible danger to workers required to withstand it over long periods. Levels as great as 140 decibels have been recorded. Various types of silencer have been developed, with the result that the noise is reduced to readily bearable levels at close range and to levels which are not at all disturbing at a distance such as that of the powerhouse, one and a half miles away. Guests at a nearby luxury tourist hotel are not inconvenienced.

The most effective silencer now being built as part of the standard wellhead equipment is a twin-tower cyclone type consisting mainly of two 12-ft. reinforced-concrete pipes each 6 ft. in diameter. The steam, entering at the bottom, is divided by a steel splitter between the pipes. The water separated by the resulting spiral flow leaves *via* a weir at the base of the silencer, the steam escaping from the tops of the twin pipes with a sound which, heard from a distance, is not unlike the roar of a heavy surf.

Cape York Peninsula Bauxite

The first paper in a Symposium on Aluminium in Australia held in Brisbane on July 16 and 17 by the Australasian Institute of Mining and Metallurgy, Southern Queensland Branch, the Australian Institute of Metals, Brisbane Branch, and the Royal Australian Chemical Institute, Queensland Branch, was by H. J. Evans, chief geologist to Commonwealth Aluminium Corporation Pty., Ltd., and entitled " The Geology and Exploration of the Cape York Peninsula Bauxite Deposits in Northern Queensland." The following notes describing the bauxite of the Weipa formation are abstracted. The ore, which consists of a mixture of trihydrate (gibbsite) and monohydrate (boehmite), occurs as a flat-lying to gently-dipping laterite varying in thickness from a few feet to 30 ft., overlying sands, clays, and silts of probable Tertiary age. The laterite can be divided roughly into two main zones. The upper zone, which constitutes the main bauxite ore, is strongly pisolitic. The pisolites are spherical and vary in size from 10 mm. to 200 mm. in diameter and are mainly uncemented. They consist of minute concentric rings probably built up around a nucleus. Occasionally the larger pisolites are found to have hollow centres containing several small uncemented pisolites in addition to clay particles and sand grains. In some localities a surface-hardened zone up to 3 ft. thick occurs, but generally the deposit is loosely compacted to friable. The second zone consists of nodular to spherical pisolites, irregular ironstone concretions, and fragments of partly bauxitized sandstone and siltstone. This zone is usually more compact than the upper bed and the nodules and pisolites are bonded together by red, brown, and grey sandy clay. The nodules invariably contain a considerable core of sandy clay and appear to represent an arrested stage of lateritization where the process of weathering and leaching has been replaced by precipitation, thus arresting the decomposition of the original rock. Thickness of the zone varies from 3 ft. to 15 ft.

The base of the upper zone is generally well defined and easily recognizable. The contrast between spherical pisolites of the upper zone and the nodular irregular pisolites of the lower bed is quite marked. The upper bed is usually much darker in colour compared with the basal bed, but owing to surface leaching in some outcrop areas this colour change is not always evident and a uniform fawn to grey colour has been noted in several localities. The base of the lower bauxite zone is not always clearly defined and is frequently very


LOCALITY MAP
N
THURSDAY IS.
HORN IS.
Cape York
TURTLE HEAD IS.
Vrilya Point
Hunter Point
GULF OF CARPENTARIA
MAPOON MISSION
Cape Granville
Possible Pumping Station
Possible Pipe Line
Duffen Point
ALBATROSS BAY
Weipa
Portland Roads
Cape Weymouth
Cape Direction
Possible Dam Site
Pera Head
MEROMA HILL
ARCHER BAY
KURUKUN MISSION
ARCHER
COEN AIRSTRIP
COEN
Cape Melville
PRINCESS CHARLOTTE BAY
Aboriginal
SOUTH PACIFIC OCEAN
QUEENSLAND
NORTHERN TERRITORY
SOUTH AUSTRALIA
NEW SOUTH WALES
COOKTOWN
CAIRNS
TOWNSVILLE
MACKAY
ROCKHAMPTON
BRISBANE
MT ISA
REFERENCE
Area covered by Authority to Prospect 28 M.
Special Mining Lease Area 2270 sq.m. approx.
Eastern Bauxite Field in respect of which the Company is entitled to take up Special Bauxite Mining Leases to the extent of 500 sq. miles. Area 1480 sq.m approx.
Area covered by Authority to prospect 53 M- held by Alcan.
COMMONWEALTH ALUMINIUM CORPORATION
MAP OF NORTHERN PORTION
CAPE YORK PENINSULA
SHOWING SPECIAL BAUXITE MINING LEASE, EASTERN BAUXITE FIELD, AUTHORITY TO PROSPECT 28M AND ALCAN'S AUTHORITY TO PROSPECT 53 M.
SCALE IN MILES
142°
143°
144°
11°
12°
13°
14°
15°

irregular. The change from nodular bauxite to unlateritized Tertiary sediments is usually transitional and marked by a gradual increase in the amount of partly lateritized fragments of the underlying sediments.

The amount of monohydrate in the bauxite varies considerably, ranging from a few per cent. to as high as 40% in a few exceptional cases. Although some anomalies occur definite distribution patterns have been observed. As a general rule the amount of monohydrate decreases with depth, the very high percentages usually being confined to the upper 3 ft. to 6 ft. of the vertical section. This concentration of the monohydrate in the upper part of the section suggests that it may be due to secondary weathering and possibly related to the air-water interface zone representing the seasonal fluctuations of the top of the water table. Although high temperatures and pressure are required in the laboratory to convert trihydrate to monohydrate it is conceivable that a similar reaction could take place at normal temperature and atmospheric pressure over a long period of time during the formation of a bauxite deposit.

The distribution of silica in the bauxite is also very irregular, but, like the monohydrate, definite distribution patterns have been observed. Within the pisolitic zone there is a general decrease of total silica with depth down to about two-thirds of the total bauxite zone. Below this point the silica tends to increase again; as a general rule it is closely related to the trihydrate curve.

The upper high-silica zone may in part represent silica deposited by mechanical means from the overlying soil but probably also represents a zone of minimum water-table effect. The low-silica zone would represent the section of the deposit that was more or less continuously below water level and therefore subjected to constant solution of silica. The ideal conditions that probably occurred during the early stage of the formation of the laterite have of course been altered as uplift and partial erosion have taken place since the formation of the laterite. Some of the anomalies so far noted are probably due to this uplift and erosion.

The Tertiary laterites in Cape York Peninsula cover an area of at least 500 sq. miles but not all of this laterite can be classed as bauxite. In the Weipa area economic-grade bauxite exists over an area of approximately 200 sq. miles and probably constitutes one of the largest single deposits of bauxite in the world. To prove the grade and tonnage in this vast deposit will require many years of detailed drilling. The drilling done to date has proved many millions of tons of economic-grade bauxite and reconnaissance work so far completed suggests that the ultimate tonnage could exceed 1,000 million tons.

The testing of the extensive flat-lying bauxite deposits has been carried out in two main stages—scout drilling at widely spaced intervals to give a broad picture of grade and thickness, followed by relatively closely spaced drilling or pitting in areas in which high-grade bauxite was indicated by the scout drilling. Because the bauxite is predominantly loose and pisolitic standard diamond drilling methods could not be used and accurate and rapid sampling of the laterite required the development of special methods and modification of standard drilling equipment. It appeared that a combination of the slow-drilling hand post-hole digger and the fast-drilling spiral auger would be the ideal sampling tool for the bauxite. A new type of auger was then designed. This consisted of a standard spiral cutter of 1½ turns attached to a cylindrical barrel to retain the sample. The leading edges of the auger cutter were designed to give ¼-in. clearance on each side of the barrel. This auger proved to be fast and accurate, eliminated contamination from the sides of the hole, and gave 100% recovery of the sample. A 6-in. diameter auger was finally adopted as a standard. This produces about 32 lb. weight of sample per foot drilled, each foot of hole drilled being kept as a separate sample.

The samples from individual bore-holes are normally analysed for total silica, quartz, trihydrate, and total available alumina. Samples representing prospect squares or evaluation blocks are subjected to a more detailed analysis. Total silica, quartz, total available alumina, iron, titanium, and ignition loss are determined. In addition, a complete analysis of the red mud, remaining after the extraction of alumina, is carried out and soda and alumina losses calculated.

As all evaluation drilling is carried out on a uniform grid system the completed area consists of a series of 2,000-ft. by 2,000-ft. squares. These are called prospect squares and are numbered systematically. The grade of each square is calculated by multiplying the average value of each hole by the depth, adding the values so obtained and dividing the total values by the total depth. Tonnage for each square is obtained by multiplying the average depth by a tonnage factor of 160,000.

Trade Paragraphs

Elcontrol, Ltd., of Wilbury Way, Hitchin, Herts., have produced a revised catalogue of their fluid level control equipment and electronic relays, including probe fittings.

Soil Mechanics, Ltd., of 65, Old Church Street, London, S.W. 3, announce the formation of a new company—Soil Mechanics-Soletanche, Ltd., which will carry out geotechnical processes such as rock grouting, alluvial grouting, and other specialist engineering services including bored shaft foundations.

Padley and Venables, Ltd., and **Joy-Sullivan, Ltd.,** have jointly formed a private company to be known as **Padloy-Sulmet, Ltd.,** of Dronfield, Sheffield. Its activities will be confined to the manufacturing and marketing of their coal cutter pick production. Under this arrangement their respective trade names of "Padloy" and "Sulmet" will be discontinued as soon as production and marketing arrangements allow.

Holman Bros., Ltd., of Camborne, Cornwall, announce that their subsidiary company **Climax Rock Drill and Engineering, Ltd.,** in conjunction with **F. Taylor and Sons (Manchester), Ltd.,** of Bolton Road, Salford, have secured an order worth more than £250,000 from Russia. The equipment to be supplied includes track-mounted mobile drilling rigs equipped with medium-weight drifters on hydraulic booms for faces up to 32 ft. high, together with telescopic carriages similar to those exhibited at Olympia last month and referred to in the July issue and of which an illustration appeared in the June number.